PUBLISHED EVERY SATURDAY BY
THE W. J. JOHNSTON COMPANY, Limited.
167-176 TIMES BUILDING, NEW YORK.
Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 28 Hathaway Building, Boston.
Western Office, 465 The Rookery, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR $3.
(Including Postage in the U. S., Canada or Mexico.)

Address all communications to
THE W. J. JOHNSTON COMPANY, Ltd.,
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VOL. XX. NEW YORK, SEPTEMBER 17, 1892. NO. 12

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Telephone Lines to Quarantined Ships.

WERE it not for the general state of demoralization into which quarantine matters have fallen, it would create surprise that no attempt has been made to connect the cholera ships, or at least those containing cabin passengers, with the shore by telephone or telegraph. This is perfectly feasible, and there are light ships thus connected, while buoys are even supplied with the electric light by means of cables under water. Had authority been in less autocratic and wiser hands the probabilities are that suggestions to this end would have been acted upon, or the Federal authorities would have had the work done by the Light House Board, which has had practical experience in the matter. It is to be hoped that when matters get straightened out the attempt will be made, and hereafter the necessary material kept on hand to connect with pest ships.

Incandescent Lamp Tests.

IN another column will be found a very comprehensive test of the life and efficiency of a number of makes of incandescent lamps, together with a formula for determining the relative values of lamps of various types. These tests were made in the testing room of a large electrical illuminating company for the purpose of ascertaining the best lamp for general central station use. The test differs from nearly all of those heretofore made, in that the conditions under which the lamps were tested were those that are found to exist in everyday central station practice rather than the somewhat artificial conditions of the laboratory. As described by Mr. Gossler in his report of the test, the voltage to which the lamps were subjected was that of the central station distribution mains from which the current was taken for supplying the banks of lamps to be tested. For this reason the results of the test will be regarded by many central station men as more valuable than any that have heretofore been published.

Magnetic Field Measurements.

A PORTABLE instrument for measuring the strength of magnetic fields which would combine a good range with a fair degree of accuracy has long been desired. The ballistic galvanometer has in the past been the recognized standard for such work and as a laboratory instrument gives excellent results. It cannot be used, however, in a varying magnetic field as, for instance, in proximity to a dynamo or motor, and is too delicate for the dynamo-builder or the practical electrician. The Weston voltmeter has been employed for this purpose, and for certain kinds of work has proved very satisfactory, but it is not sensitive enough for any but very intense fields. An instrument has been devised by Messrs. Edser and Stansfield, described elsewhere in these columns, which appears to possess the accuracy of the ballistic galvanometer and the portability of the voltmeter. It is very simple in construction and operation, requiring only a dry cell and a resistance box. The principle is the inversion of the D'Arsonval galvanometer, the torsion necessary to restore a coil, carrying a constant current, to its normal position parallel to the lines of force being proportional to the strength of the field for any given position of the coil. The sensitiveness of the instrument can be varied by the introduction of an independent resistance, and readings can be taken with considerable rapidity. As its range is great and it is accurate to within two per cent. it gives promise of considerable practical value.

A National Physical Laboratory.

THE article of Mr. A. G. Webster in THE ELECTRICAL WORLD of Aug. 6, followed by a discussion on the same subject before the British Association for the Advancement of Science, has reawakened interest in the establishment of a national physical laboratory in America, and we are happy to announce that steps have been taken that will probably lead to a realization of this important work. In another column will be found an article from Mr. F. G. Bolles and Mr. U. S. J. Dunbar, who tender their services to organize, with the co-operation of Major Powell, of the U. S. Geological Survey and Prof. T. C. Mendenhall, of the U. S. Coast and Geodetic Survey, a movement to bring the subject before Congress in a manner that will insure its its almost undoubted success. We most heartily commend the plans of Mr. Bolles and place our columns at the disposal of those interested in the success of the great work, and trust that our readers will in every way in their power assist in its accomplishment. Electrical science will be most benefited by such a laboratory, not only on account of the facilities it will offer for practical work, such as unbiased tests, calibration and practical experimental work, but also in offering ways and means for investigations of many of the higher problems of electrical science. Through the Royal Institution of London the world has had a Young, a Davy, a Faraday and a Tyndall, and a laboratory such as is proposed would undoubtedly develop similar minds. Some of the greatest names in American science would be missing if the National Observatory, the Smithsonian Institution, the Coast and Geological Surveys and the Weather Bureau had not afforded opportunities for their exercise free from other engrossing occupation. Mr. Bolles and Mr. Dunbar and the gentlemen associated with them deserve the thanks of all Americans interested in the elevated position their country would occupy in the scientific world, and we sincerely trust that they will meet with the generous co-operation they and their object merit.

The Ever Victorious Trolley.

SEVERAL of our lay contemporaries continue their merry war on the trolley, unconscious of the opera bouffe air it has assumed, and with as much probability of success as their more chivalrous prototype met with in his attack on a windmill. The mendacious character of their onslaughts at first, no doubt, irritated some of those who could appreciate the gross injustice attempted, but at present they excite a merely languid interest not unmixed with contempt. The general public, apparently, has never had any sympathy with the opposition to the trolley, and that none has been excited is evidence that the bias and virulence of the attacks have been rated at their true value. With arc light and primary alternating current wires everywhere, both carrying really "deadly" currents, and the former often winding through interiors, sometimes almost within reach, the people simply show common sense by not becoming alarmed at the low voltage current trolley wire confined to the streets alone. The trolley system is impregnable except on the score of sightliness, and in this respect it is of course vastly superior to the elevated railway. The superior control of the trolley car and less liability of breakdowns in operation, combined with greater flexibility and cheapness, leave its only rival, the cable system, at a disadvantage. We venture a prophecy that not long after the adoption of the "deadly" trolley a cry will go up to have that system substituted in our busy streets for the "deadly" cable whose adoption met with little or no opposition, notwithstanding its long list of bona fide victims from grips refusing to release or from the lack of control in which it is so inferior to the electric car. Recently one of our daily contemporaries sent queries to the mayors of towns using the trolley system, and of over a hundred replies received, not one was unfavorable to it. We kindly advise the opponents of the triumphant trolley to retire from the field in as good order as their present demoralized state will permit, and we feel that in a year or so hence as they ride to and from their offices over a trolley road they will appreciate the wisdom of our advice and the depths of their folly in opposing the inevitable, which in this case coincides with the best.

The Library Method of Study.

THE address of Prof. Albert H. Prescott, the retiring president of the American Association, at the recent Rochester meeting of that body of scientists, contained a strong plea for what he was pleased to call the "library method" of scientific study. By this was meant the liberal use of a well-stocked library containing the original memoirs of other and earlier workers along the same lines of research in connection with the experimental work of the laboratory. It is undoubtedly true, as Professor Prescott points out, that much valuable time and earnest work are wasted by investigators who do not take the time and trouble to first become acquainted with the scientific records left by those who have traveled over the same or similar lines of experimental inquiry. "To every solitary investigator," says Prof. Prescott, "I should desire to say, get a library of your subject, learn how to use its literature, and possess yourself of what there is on the theme of your choice, or else determine to give it up altogether. You may get on very well without college laboratories, you can survive it if unable to reach the meetings of men of learning, you can do without the counsel of an authority, but you can hardly be a contributor in science except you gain the use of its literature." Although these remarks were made especially with regard to the literature of chemistry they apply with equal force to the literature of electricity. No investigator in this line of research can afford to waste his time in doing original work on any subject without first consulting the memoirs of other and earlier workers. By so doing he not only avoids the danger of repeating that which has already been well done by others, but receives suggestions that are invaluable for his work in new fields. But how, it may be asked, is one to know where to find these memoirs if they are buried in some of the thousands of volumes of society proceedings or scientific journals that any man might spend a lifetime in examining without finding what he wanted. This is certainly a fair question and it is to be regretted that there is no comprehensive index to this class of electrical literature to which the diligent student may be referred, for "a systematic bibliography," to quote again from Prof. Prescott, "both of previous and current literature, would add a third to the productive power of a large number of workers." The need of such an index has been felt by many students of electrical literature, and it may, indeed, be regarded as an open question whether any investigator can afford to spend the time necessary to search even hurriedly the field of electrical literature without a guide in the shape of an index. Prof. J. B. Johnson, of Washington University, in the preface of "A Descriptive Index of Current Engineering Literature," which covers the period of 1884 to 1891, goes so far as to say that "an index without a library is of more value to the student than a library if he has no index to its contents." The best indexes to electrical literature are at best fragmentary, and are widely scattered through numerous publications. It is our intention to publish in an early issue a list of the best of these that may, in the absence of a more comprehensive index, be useful to many who have occasion to consult the already voluminous and daily growing mass of electrical literature.

Electric Lighting at Frankfort.

BY JOSEF HERZOG.

The following extracts from the recently published "Electrical Works at Frankfort-on-the-Main" may prove of interest. This report has been published by order of the city of Frankfort. As the result of accurate investigation and calculations the committee has arrived at the conclusion that under favorable conditions a paying electrical station can be established for the consumers of electrical light and power and that the system most to be recommended and best adapted to local conditions would be an alternating current transformer system.

For the first project 21,000 incandescent 50-watt lamps and for the second 67,000 have been suggested. The accompanying tables show the cost and probable income of the various systems. Two years ago discussion was very active in Frankfort in regard to these matters, but experts then could not arrive at a final conclusion. My suggestions now may help to settle the issue.

I.

COMPARATIVE COST OF AN ELECTRIC PLANT AT FRANKFORT ON-THE-MAIN, ACCORDING TO VARIOUS SYSTEMS OF DISTRIBUTION.

Project 1.—*For* 21,000 *or* 25,000 *50-watt lamps.*

	Alternating current with transformers.	Accumulators with direct current.	Accumulators with conversion.
I. Cost of site	$54,000	$91,500	$91,500
II. Buildings	120,400	103,900	103,900
III. Auxiliary stations.	4,720	4,900	55,200
IV. Street works	48,800	55,000	55,000
V. Boilers, pipes, etc.	42,900	32,800	32,700
VI. Engines, transformers and accumulators	167,700	248,000	286,500
VII. Distribution network	170,000	409,000	225,500
VIII. Electric meters	73,800	90,500	90,500
IX. Miscellaneous	30,450	36,000	34,750
	$712,770	$1,115,700	$975,550

Project 2.—*For* 67,000 *50-watt lamps.*

I. Cost of site	$54,000	$106,800	$106,800
II. Buildings	117,800	147,900	147,900
III. Auxiliary stations.	12,500	76,300	87,000
IV. Street works	137,700	155,000	152,500
V. Boilers, pipes, etc.	97,600	69,000	69,000
VI. Engines, transformers and accumulators	429,000	595,000	686,000
VII. Distribution network	452,000	1,245,000	627,500
VIII. Electric meters	221,500	221,500	221,200
IX. Miscellaneous	61,000	80,500	70,200
	$1,643,100	$2,697,000	$2,168,100

II.

COMPARISON OF ANNUAL INCOME AND EXPENSES FOR THE THREE SYSTEMS.

Project 1.

	Alternating current with transformers.	Accumulators with direct current.	Accumulators with conversion.
Income	$168,000	$199,900	$199,900
Expenses	113,050	156,000	144,950
Profit	$54,950	$43,950	$54,950
Per cent. profit	7¾%	4%	5⅛%
Invested capital	$712,500	1,113,000	974,000
Dividend	11¾%	8%	9⅛%

Project 2.

Income	$404,000	$404,000	$404,000
Expenses	270,500	383,500	338,000
Profit	$133,500	$20,500	66,000
Per cent. profit	8%	¾%	3%
Invested capital	1,642,000	2,699,000	2,163,000
Dividend	12%	4¾%	7%

The Establishment of a National Physical Laboratory.

BY F. G. BOLLES AND U. S. J. DUNBAR.

The article by Mr. A. G. Webster on "A National Physical Laboratory," published in THE ELECTRICAL WORLD of the 6th ultimo, is surely in harmony with the necessities of our great and growing republic at the present time, and every one interested in the establishment of an institution of this kind should contribute suggestions as to the necessities of and benefits to be derived from an addition of this kind to our government institutions. To secure an appropriation for this purpose it will be necessary to move the "powers that be" by bringing to bear the very best of argument for this exceedingly advantageous and necessary department for scientific research and standardizing.

This argument should be culled from communications received; it should be concise and to the point and at the proper time should be used in the interests of the bill to be presented to Congress. The question naturally arises, who shall take up this work? A great many may think it proper that it should be by some of our scientific societies, and in fact such would be the case if we could content ourselves with many long years of waiting. This, it would seem, is hardly necessary when with a united effort we can, in all probability, secure an appropriation in a reasonably short time.

If a society is to proceed with the matter it will very likely result as in the case cited by Mr. Webster. Such a result is due mainly to the fact that the matter is not given sufficient time and attention by those having it in charge. The society meets quarterly, semi-annually, or, perhaps, no oftener than once a year, and the enthusiasm lags in the meantime.

Perhaps a committee may be appointed to investigate and secure data, but owing to the already burdened condition of its members the subject must necessarily be treated hurriedly and with neglect. It is possible that the society may reach that point when it becomes necessary for Congress to act, and the whole matter is turned over to one or more of our worthy lawmakers.

But here, as in the society, neglect is almost sure to occur, as they are always well crowded with business to which our "laboratory" is a secondary matter, and from a political point of view they are perhaps quite right.

They do not have time to thoroughly explain the advantages to their colleagues, and the result is inevitably a failure.

We believe there is but one way to bring this matter to a successful conclusion, namely: for all interested societies and individuals to send their approvals, recommendations, etc., to some one who will devote the necessary time to the matter every day, and who will, when the necessary data have been received, under the direction of several of our eminent scientists, to be hereafter designated, proceed to properly frame a bill for the establishment of "A National Physical Laboratory."

When this is complete the task of working up sufficient interest among the members of Congress must be taken up. To each individual member must be explained the benefits to be derived, and a "cast iron" argument showing the necessities for an institution of this kind presented. When this work is completed it only remains for it to be acted upon by Congress. Little argument will be needed at this time, as each member has been fully acquainted with the merits of the bill and can act intelligently.

Our interest in the subject, coupled with an extensive personal acquaintance among the members of Congress, and our residence in the city where the bulk of the work must be done, has induced us to tender our services to carry out the laborious part of this work.

We have secured the co-operation of Major Powell, Director of the United States Geological Survey, and Prof. T. C. Mendenhall, Superintendent of the United States Coast and Geodetic Survey. They approve of our mode of procedure and will direct us in our undertaking. We hope also to secure the co-operation of Profs. Langley and Good, of the Smithsonian Institution, who are now abroad.

With the advice of these four very eminent scientists we believe that our work will progress very rapidly and hope that a lively interest will be shown from the very start. We would suggest that communications be forwarded us by any who may choose to contribute. All suggestions will be carefully considered and acknowledged.

We hope to receive communications from the many able gentlemen throughout the country who will certainly be interested in the practical work to be taken up by an institution of this kind as well as for the advancement of science upon the American continent.

2,133 Virginia Ave., N. W., WASHINGTON, D. C.

Action of the British Association on Electrical Standards.

The action taken by the British Association at Edinburgh on the subject of electrical standards may prove to be of considerable importance. The subject was brought up in this way: Last May Dr. von Helmholtz addressed a letter to Lord Kelvin (Sir William Thomson), expressing the hope that an absolute uniformity might be reached in England and Germany with regard to the legal electrical standards. It was then decided that a conference on electrical standards would be held at the Edinburgh meeting, and invitations were sent to Dr. von Helmholtz, to the Bureau Internationale at Paris, and to Prof. Rowland at Baltimore, Md. Prof. Rowland was unable to be present, but Prof. Carhart attended the conference and furnished some valuable information in regard to the Clark cell. France was represented by M. Guilleaume.

The dimensions of the column of mercury which has a resistance of one ohm was the first subject which came up for discussion. Prof. von Helmholtz called attention to the difficulty of defining the cross-section of a column in terms of the square millimetre, and pointed out that this could be met by defining the mass of a column of given length which should have the required resistance, and it was agreed to define this mass in such a way that assuming the mass of one cubic centimetre of water to be one gramme the area of cross-section should be one square millimetre. In regard to the length of the column the various experiments which have been made to determine this were thoroughly discussed, and it was decided that 106.3 centimetres might be taken as the length of the column with an accuracy of nearly one part in 10,000.

The question of practically realizing the standard of resistance was then dealt with, and the distinction drawn between the practical unit of resistance and the "legal standard" of resistance. It was decided to omit all reference to the B. A. unit in the resolutions. It was thought that a standard in solid metal having the same resistance as the specified column could be made with considerable exactness, and that such a standard possessed the advantage that it could at any future time be recovered with greater certainty than was possible in the case of the wire coil. As a result of the discussion the following resolutions were adopted:

1. That the resistance of a specific column of mercury be adopted as the practical unit of resistance.

2. That 14.4521 grammes of mercury in the form of a column of uniformsection 106.3 cm. in length at 0°C. be the specified column of mercury.

3. That standards in mercury or solid metal having the same resistance as the specified column be made and deposited as standards of resistance for industrial purposes.

4. That such standards be periodically compared with each other, and also that their values be redetermined at intervals in terms of a freshly set up column of mercury.

The electromotive force of the Clark cell was a subject which received considerable attention. After a careful comparison of the results of various experimenters it was agreed that the number 1.434 volts at 15 degrees centigrade might be taken as the electromotive force of the cell.

Prof. von Helmholtz expressed his entire agreement with the resolutions passed, and said that they were in accord with the ones which had been laid before the German government, and M. Guilleaume expressed the opinion that the French government would concur in the recommendations. It was also thought, according to the assurances given by Profs. Rowland and Barker at Leeds two years ago, that these figures would be adopted in the United States.

NEW BOOKS.

THE PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS. By Francis B. Crocker and Schuyler S. Wheeler. New York. D. Van Nostrand Co. 1892. 99 pages and 37 illustrations. Price, $1.00.

This little book is made up of a series of articles that appeared in the columns of *The Electrical Engineer*, between September, 1891, and May, 1892. The intention of the authors as stated in the preface has been to give simple directions for the practical use and management of dynamos and motors. The work is divided into two parts, the first treating of the practical management of and the second the localization and remedy of troubles in dynamos and motors. In the first part the ground covered will be indicated by the chapter headings, which are as follows: General principles of selecting, installing, starting, running, stopping and testing dynamos and motors.

The ground covered by the second part is also best indicated by the headings of the nine chapters, which are here given: Sparking at commutator, heating in dynamo or motor, general instructions, heating of armature, heating of field magnets, heating of bearings, noise, speed too high or low, motor stops or fails to start, dynamo fails to generate.

The treatment of the subjects chosen is of the most practical character, as the directions given are intended as a guide for those who use or study the construction of dynamo electric machinery. The book will undoubtedly prove of great value to those who are engaged from day to day in the handling of this class of machinery and are called upon to locate and remedy the slight but annoying defects in the operation of a dynamo or motor. The style in which the book is arranged, the different subjects treated having bold face side headings, makes reference to any topic in the book a very easy matter. The separate paging of the two parts, however, is a very annoying feature and one which might easily have been remedied.

LITERARY NOTES.

We have received some advance pages from the forthcoming work of Mr. Oliver Heaviside on "Electromagnetic Theory," to be issued by the Electrician Printing and Publishing Company, of London. This will form a volume of uniform size and style with Fleming's "Alternate Current Transformer" and Ewing's "Magnetic Induction in Iron and Other Metals." It is in fact another volume of the well known *Electrician* series.

Some advance pages have been sent to us of a little book which will soon be issued by the Electrician Printing and Publishing Company, entitled "A Pocketbook of Electrical Engineering Formulæ," by W. Geipel and M. Hamilton Kilgour. The abstract of the table of contents indicates that it will contain information regarding water power, steam and gas engines, dynamos and motors, transformers, insulators, arc and incandescent lamps, batteries, the transmission of power, electric railways, etc., etc. It will be of pocket book size.

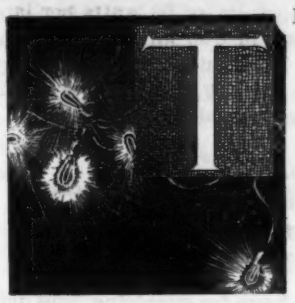
Besides the two books just mentioned the Electrician Printing and Publishing Company has in preparation three others which are announced to be ready at an early date. These are "Submarine Cable Laying and Repairing," by H. D. Wilkinson; "Drum Armature Winding and Commutators," by F. M. Weymouth; and "Electricity as a Motive Power," by Albion T. Snell.

Three new books are announced by the Bubier Publishing Company, of Lynn, Mass. The first of these is "How to Make and Use Induction Coils," by Edward Trevert, and is sold in cloth binding for 50 cents. The second is "Questions and Answers About Electricity," by T. O'Conor Sloane, Caryl D. Haskins, A. E. Watson and Edward Trevert, and its price in cloth binding is 50 cents. The third is on "Transformers," by Caryl D. Haskins, and is sold in cloth for $1.25.

Those who have frequently wished to have access to the important papers of Dr. John Hopkinson, collected into some definite shape for reference, will be gratified to learn that the W. J. Johnston Company, Limited, has in press a little volume which will contain eleven of Dr Hopkinson's original papers on dynamo machinery and allied subjects. This volume will be uniform in size and price with Prof. S. P. Thompson's "Lectures on the Electromagnet," issued in 1891, and will contain three of Dr. Hopkinson's papers on the subject of electric lighting, his two important papers on dynamo-electric machinery, two papers on alternate current work, one on induction coils, and his recent report to the Westinghouse company on an elaborate transformer test made by him for that company, besides his paper on electric lighthouses, and a brief paper on an unexpected danger in certain apparatus for the distribution of electricity.

Life and Efficiency Tests on Incandescent Lamps, with a Formula for Determining the Relative Values of the Different Makes of Lamps.

BY P. G. GOSSLER.



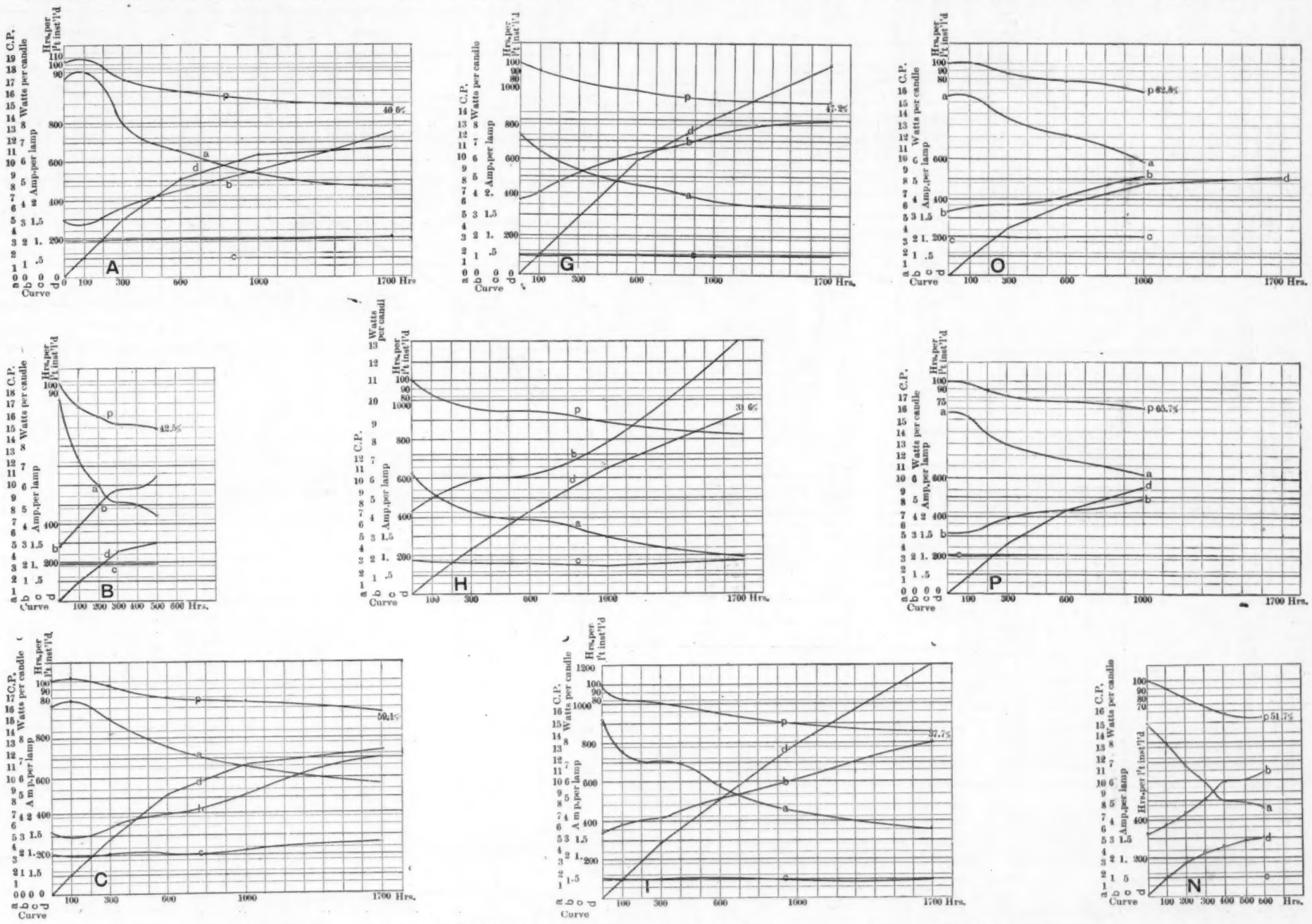
THE following is an account of a life and efficiency test on various makes of incandescent lamps, made in the testing room of a large electrical illuminating company. The object of the test was to determine the best lamp for central station use, by which is meant a lamp that is most satisfactory to the customer, and at the same time most economical to the illuminating company. The results are of a special value from the fact that throughout the test the conditions under which the lamps were run were made to conform with the conditions imposed upon lamps in central station practice.

Ten different kinds of lamps were secured for the test, most of them coming from the store-room of the illuminating company or bought in the open market. Twenty lamps were taken at random from each lot of lamps, and carefully measured for candle power and current consumption, at 50 or 100 volts, according to the markings on the lamps. The lamps were placed on a large lamp-board which had been made for the purpose, having heavy copper bars at the bottom, which were fed from a bank of converters, on the three-wire system. The 50-volt lamps were so connected that the two sides of the three-wire system were equally balanced, the 100-volt lamps being connected to the outside wires of the same system. This arrangement secures exact equality of voltage on all of the 200 lamps placed on the board, except that the voltage on the 100-volt lamps was double the voltage on the 50-volt lamps. The rated capacity of the bank converters, to which the 200 lamps were connected, was 240 lamps. A number of lamps broke during the first few hours of the test, which reduced the load on the converters to about three-quarters of the rated capacity, this being approximately the average load in practice. The bank of converters was connected to the distributing mains of a commercial circuit, to which about 2,200 commercial incandescent lamps were connected, and the lamps in the test board burned under the same conditions of pressure as the lamps in customer's premises. The lamps were burned continuously, candle power and current measurements being made at a pressure of 50 and 100 volts when the lamps were new, and after they had burned 100, 300, 600, 1,000, and 1,700 hours. The voltage at which the lamps burned in the lamp-board was measured by a standard voltmeter, the measurements being made as often as fifty times a day during the early part of the test, but this was not continued during the entire time, the measurements being made but three or four times a day during the latter part of the test. It is shown in the tables that the average E. M. F. on the 50-volt lamps was from 51 to 52 volts, while on the 100-volt lamps it was double this. No effort was made to keep the current and E. M. F. on the lamps constant at 50 volts during the life test, the lamps being burned at the average voltage on the circuit from which they were fed. The average E. M. F., as stated in the tables, was from 51 to 52 volts. However, it was carefully controlled during the candle power and current measurements all measurements being made at 50 and 100 volts. The arrangements provided secured for the lamps in the test room the same conditions as to voltage, etc., that they had on the other lamps that were connected to the station, and especially the lamps connected to the distribution mains, from which the test room drew its supply of current. After the 200 lamps had run 400 or 500 hours, a second test was started on five of the 50-volt makes, which seemed to be leading in the early part of the first test. The purpose of the second test was to find the effect on the lamps of increasing the pressure about 10 per cent. For this purpose 10 new lamps of each of the five kinds were placed on a second lamp board, with converters so connected that they would burn at 10 per cent. higher pressure than the lamps in the first test. The 50-volt lamps in the first test are lettered A, C, E, H, J, L, O, and P, and the 100-volt lamps are lettered G and J. The lamps in the second test are lettered B, D, F, K and N.

There are in all 15 groups of lamps, representing 13 groups of 50-volt lamps, and two 100-volt groups. The 13 groups of 50-volt lamps represent but eight different makes, five makes in the first test being duplicated in the second test. The two 100-volt groups in the first test were made by the same makers as two of the 50-volt groups. The tables and curves for the same kinds of lamps are lettered as follows: A and B are of the same make, C and D are of one make, E and F are the same, J and K are the same, and those lettered L and N are of the same make.

The 100-volt group marked G is from the same factory as the 50-volt lamps marked H, and the 100-volt group marked I is of the same make as those marked L and N. The last measurements were made after the test had been running 1,700 hours, and it will be seen from the second and fifth columns, in the same tables, that there are still lamps that would not be considered dead for ordinary lighting purposes, especially on circuits that are run as this test circuit was, at an average voltage of 2 per cent. to 4 per cent. above that for which the candle power measurements were made.

The candle power measurements were made on an ordinary Bunsen sliding photometer, the scale of which was 96 inches in length, and marked to read directly in candles. The standard used was a selected incandescent lamp, placed on the same circuit as the lamp being measured. The object of doing this was to secure comparative c. p. measurements that would be correct for all the lamps at exactly 50 volts, and any error from unavoidable variations in voltage on the lamp being measured was approximately neutralized by the varying of the voltage on the standard to exactly the same extent, or keeping the voltage on the two lamps exactly equal. More accurate comparative measurements were secured in this manner than can be had when an ordinary gas standard of c. p. is used. The standard lamps were secured by taking 100 lamps and seasoning them by burning them 10 hours at a high voltage, and selecting from these as standards lamps which measured 16 candles. The efficiency of the standard lamps was approximately the same as that of those being measured. The voltage was taken by means of a carefully standardized voltmeter, and the current measurements were made with two Seimens electro-dynamometers. The lamps were measured for current in groups of 10, and the average current of the group taken.



CURVES A, B, C, G, H, I, N, O AND P, SHOWING THE RESULTS OF LIFE AND EFFICIENCY TESTS OF INCANDESCENT LAMPS.

The results of the tests on the different makes of lamps are given in the tables and plates, for which the following explanation will be sufficient. Each group of 20 lamps is designated by a letter, and the plates bear the same letters as the tables, from which they are constructed. The curves on the different plates, representing the same thing, are all drawn on the same scale and bear the same letter throughout, as on plate A, curve a represents the candle power, measured at 50 volts, at various stages during the test; b is the curve representing the watts per candle, at 50 volts; c the curve giving the amperes per lamp at 50 volts; p gives the percentage of the initial candle power; and d gives the number of hours burned per lamp, installed for any of the time intervals at which the measurements were made; time is a factor common in all of the curves. The figures at the bottom of the plates, in horizontal rows, are common to all the curves, and represent hours that each lamp has burned. The vertical rows of figures, lettered "a,"

refer to curve "a," and represent average candles per lamp at 50 volts; the vertical row, lettered "b," refers to curve "b," and represents average watts per candle, at 50 volts; the vertical row "c," refers to curve "c," and represents the average amperes per lamp at 50 volts for all unbroken lamps; the vertical row "d" refers to curve "d," and represents the average hours burned per lamp hours, burned by all of the lamps, referred to by the curve, divided by the total number of lamps originally installed in the given lot, which was either twenty or ten. The curves on the plates have been plotted from the observations made at the different periods of the time shown in the tables, and each curve represents the average result of all the measurements made on the particular lot of lamps to which it refers.

Lamps burning at a voltage above that for which they are rated give a much greater illuminating power than 16 candles, but at the same time their life is very considerably shortened. A plate showing the effect of various voltages upon the brilliancy of a lamp is given, and the effect of a 10 per cent. increase of voltage upon the lamp may be ascertained from the tables and plates by comparing the same makes of lamps which were run in the lamps in the position of maximum horizontal candle power.

The question which first presents itself after an examination of the above tables and curves, is which is the best lamp for central station use? To get a satisfactory answer to this, all of the conditions surrounding the initial cost, and cost of operating the plant, will have to be considered.

For this purpose the cost of producing light may be divided into three parts, as follows:

A—That portion of the cost of service per lamp hour that is not affected by the average efficiency and life of the lamps, and such portion of the maintenance, operating and general expenses as is not increased by increasing the current consumption per lamp hour.

B—The cost per lamp hour for coal, water, interest and depreciation on lines, dynamos, engines, etc., and such part of the expense of the service as increases proportionally to the amount of current served per lamp hour, and as the maximum station output.

C—The cost of the lamps per lamp hour, and the expenses per lamp hour of replacing exhausted lamps, which is equal to the cost of one lamp plus the cost of exchanging one exhausted lamp, divided by the average life of the lamps.

These divisions should be made so that the sum of A, B and C will represent the total cost of service per lamp hour. That part of the cost, exclusive of lamp renewals, that does not increase with an increase of current per lamp hour, should be classified under A. That portion of the cost of service per lamp hour, exclusive of the cost of renewing lamps, that increases proportionally to the current consumed per lamp hour, should be classified under B. Under the first division A is the cost of shades, sockets, fuses, fixtures, subsidiary cables and ducts, etc., and such proportion of the operating and general expenses as is not increased by increasing the current consumption per lamp hour.

The values of A, B and C, representing the above divisions of cost, having once been established for a lamp of any given efficiency and length of life for any particular central station, the cost of service per lamp hour for this same station with any other lamp which has a current consumption of X times the current consumption per lamp hour of the first lamp, and having an average life of y hours, would be,

$$A + xB + \frac{C'}{y},$$

C' being the cost of one of the new lamps, plus the cost of replacing one exhausted lamp, divided by y, the average hours of life of the new lamp. Substituting in the formula approximate values for the above expressions, and applying the assumed values to the three makes of lamps lettered J. I. and H, we get the following:

Let the cost of service per lamp hour of a central station burning lamps L (see curve L), having an average life, under actual conditions, of 1,200 hours, a current consumption of 51.5 watts at 50 volts, or 53 watts per lamp at the actual voltage burned in use, an average candle power during the life of 10.7 candle per lamp, when measured at 50 volts, or an average candle power of 12.2 candles at the actual voltage burned, be as follows:

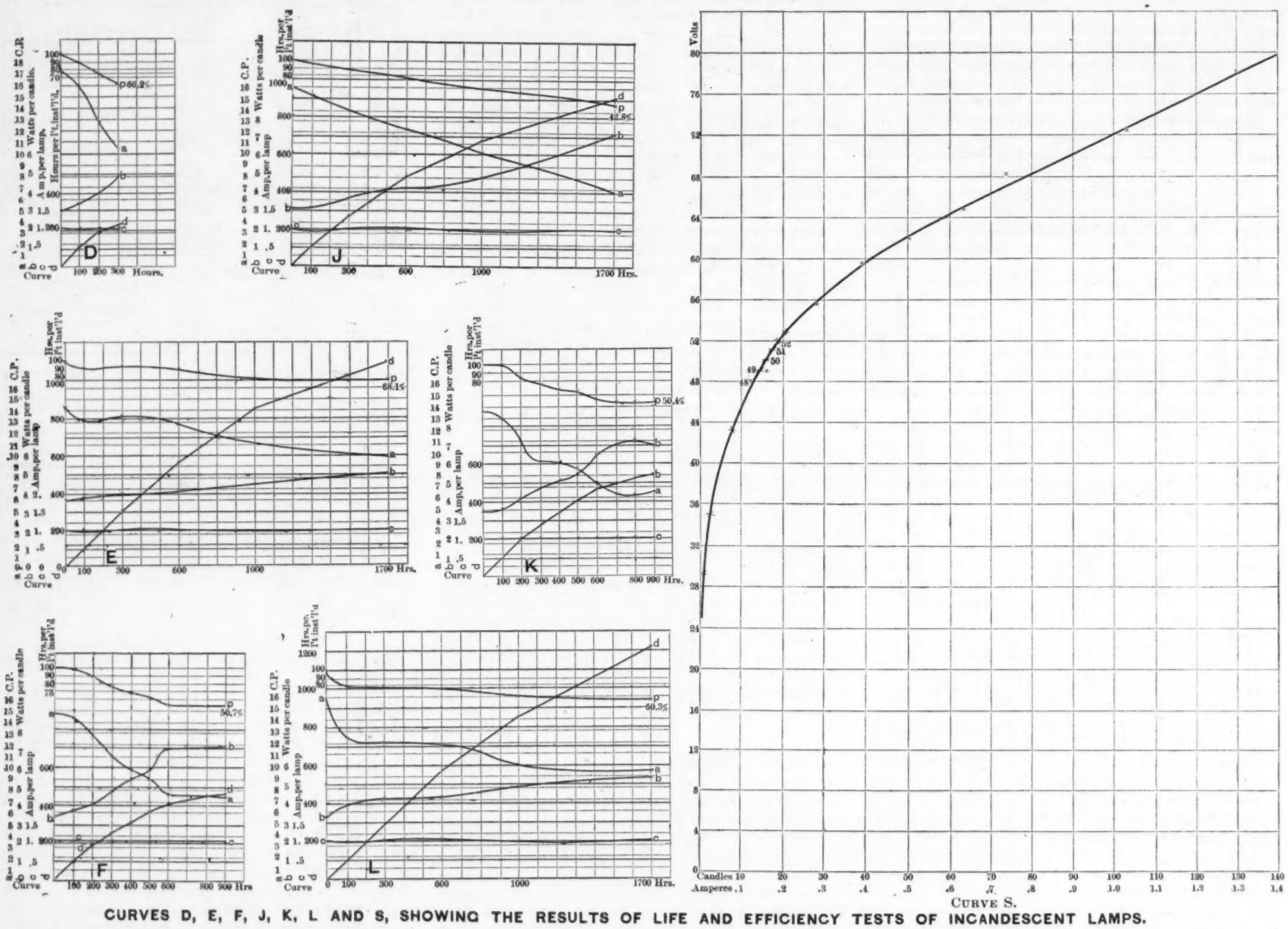
A— .45 cents.
B— .28 cents.
C— Cost of lamp, 50 cents. Cost of exchanging one exhausted lamp 1.5 cents. Average lamp life, 1,200 hours.

Substituting these in the formula, we have:

$$.45 + (.28 \times 1) + \frac{50 + 1.5}{1,200} = .7729 \text{ cent.},$$

which is the cost per lamp hour for supplying light with the make of lamps lettered L.

Let the cost of service per lamp hour of a central station burning lamps J (see curve J), having an average life under actual conditions of 700 hours, a current consumption of 50.5 watts per lamp, at 50 volts, or 52 watts per lamp, at the actual voltage burned in the test, and



CURVES D, E, F, J, K, L AND S, SHOWING THE RESULTS OF LIFE AND EFFICIENCY TESTS OF INCANDESCENT LAMPS.

the two tests. The lamps lettered L and N are of the same make, and are the lamps referred to as having been taken directly from the store-room; but it is seen from the tables that the initial tests on these lamps vary considerably, which is accounted for by the lamps coming from different invoices, received from the manufacturers at different times. It has been observed that lamps received from the factory do not average the same candle power and efficiency for different invoices; that is, lamps which are received in one invoice are usually quite uniform throughout that lot, but they vary considerably from lamps made at other times. Plate S gives the curve, showing the different illuminating powers of a 16-c. p., 50-volt, 52-watt lamp, for various voltages from 25 to 80 volts. The table from which this curve has been plotted is as follows:

Volts.	Amperes.	Candles.	Watts
25.	.561	.4	14.025
29.5	.645	.87	19.03
34.8	.774	2.47	26.94
40.	.898	5.1	35.92
48.	.9675	12.6	46.24
49.	1.032	15.	50.57
50.	1.055	15.8	52.75
52.5	1.0965	20.50	57.57
55.6	1.161	28.40	64.55
59.5	1.2255	39.30	72.92
62.	1.29	50.70	79.98
68.2	1.419	74.50	96.78
72.5	1.4835	103.20	107.54
78.	1.548	130.	120.74
89.	1.58	141.	126.40

From this curve can be approximately ascertained the candle power at which the lamps in the test burned. All candle power measurements in the test were made with

having an average candle power during life of 12.2 candles when measured at 50 volts, or an average of 14.1 candles when measured at the actual voltage burned, be:

A— .45 cents.
B— .28 cents.
C— Cost of lamp, 40 cents. Cost of exchanging one exhausted lamp, 1.5 cents. Average lamp life, 700 hours.

$$x - \frac{1.01}{1.03} = .98$$

Substituting in the formula,

$$.45 + (.28 \times .98) + \frac{40 + 1.5}{700} = .7836 \text{ cent},$$

the cost per lamp hour for supplying light with the lamps lettered J.

It is seen that the cost of service per lamp hour is less with the lamps lettered L than with the lamps lettered J, but if we find the cost of service for candle power of light given by dividing the cost per lamp hour of both makes by the average candle power given by the respective lamps while burning, we have for the lamps L,

$\frac{.7729}{12.2} = .0633$ cent, equals the cost per candle power hour,

and for the lamps $J = \frac{.7836}{14.1} = .0555$ cent, equals the cost per candle power hour, making a difference of .0078 cent per candle power hour in favor of the lamps lettered J, which have the cheaper initial cost of the two makes L and J.

Applying the formula the same way to find the cost of service per lamp hour under the same conditions as above, and using the lamps H, we have the following:

Let the cost of service per lamp hour of a central sta-

tion burning lamps H (see curve H), having an average life under actual conditions of 375 hours (this being a very liberal allowance for this lamp), and having an average current consumption of 44.8 watts per lamp at 50 volts, or 46 watts at the actual voltage burned in the test, and having an average candle power during life of 7.6 candles, when measured at 50 volts, or an average of 9.1 candles when measured at the actual voltage burned, be:

A— .45 cents.

B— .28 cents.

C— { Cost of lamp, 30 cents. / Cost of exchanging one exhausted lamp, 1.5 cents. / Average lamp life, 375 hours.

x — $\frac{.896}{1.03} = .87$

Substituting in the formula,

$$.45 + (.28 \times .87) + \frac{30 + 1.5}{.375} = 778 \text{ cent},$$

which is the cost per lamp hour for supplying light with the make of lamps lettered H, under conditions assumed.

Dividing the cost of service per lamp hour with the amps H, by their average candle power per hour, under the above conditions, we have $\frac{.778}{9.1} = .0885$ cent per candle power hour, making a difference of .0222 cent. per candle power hour in favor of the lamps lettered L, and a difference of .03 cent. per candle power hour in favor of the lamps lettered J.

This formula applies only for comparing the cost of producing light with lamps having different costs, efficiency and average lamp life, when they are to be burned in the same plant and under the same conditions of average lamp hours burned per lamp installed, and the same maximum number of lamps burning for a given number of lamps wired, etc. Value B in this formula includes the coal consumption and the materials, which practically vary proportionally to the watt hours output required for providing the light; it also includes the interest and depreciation on the plant, which must be enlarged when the lamps consume large amounts of current, because the generating and supplying capacity of the plant must be proportional to the maximum output called for by the lamps. In many plants the interest and depreciation account will form quite a considerable portion of the factor B, and as a large value to the factor B makes a showing against a high consumption of current per candle power hour very bad it would appear that any lamps installed in a plant that did not burn at the time of maximum current output from the station could be economically used of a poorer efficiency with longer life than lamps that do burn at the time of maximum output, because any additional demand for current on a plant that is not a call for current at the time of maximum output does not require an increase of plant capacity. In estimating the best efficiency per candle power hour, or per lamp hour, for these lamps that do not burn at the time of maximum output, the cost of interest and depreciation entering into the factor B in the formula (in fact, all the costs that increase proportionally as the size of the plant required to serve the lights wired) should be excluded from the factor B; the result is that lamps that do not burn at the time of maximum output can be economically used of considerably lower efficiency than lamps that do burn at that time.

A.—50-VOLT, 16 C. P. LAMPS.

Hours burned.	No. of lamps.	No. of lamps broken.	Average current per lamp, amperes.	Average c. p. per lamp.	Per cent. of c. p.	Per cent. loss of c. p.	Watts per candle.	Total lamp hours burned.	Lamp hours burned per light inst'd.	Average voltage on lamps.	Remarks. E. M. F. on Lamps.
0	20	0	.972	16.52	100	0	2.95	0			
100	20	0	.96	17.74	107.4		2.7	2,000	100	50.94	Max. 53.2 Min. 49.7
300	19	1	.975	13.5	81.8	18.2	3.61	5,882	294.1	51.3	Max. 53 4 Min. 49.8
600	10	10	.98	10.9	65.7	34 3	4.49	10,105	505.3	52.2	Max. 54. Min. 50.3
1,000	3	17	.98	8.83	53.5	46.5	5.54	12,622 8	631 1	52	Max. 53.7 Min. 51.5
1,700	1	19	1.15	7.7	46.6	53.4	7.47	13,397.8	669.9	51 8	Max. 54. Min. 50.

B.—50 VOLT, 16-C. P. LAMPS. VOLTAGE ABOUT 10 PER CENT. HIGH.

Hours burned.	No. of lamps.	No. of lamps broken.	Average current per lamp amperes.	Average c. p. per lamp.	Per cent. of c. p.	Per cent. loss of c. p.	Watts per candle.	Total lamp hours burned.	Lamp hours burned per light inst'd.	Average voltage on lamps.
0	10	0	.96	17.4	1'0	0	2.72	0		
100	9	1	.95	12	69	31	3.95	957	95.7	55.4
200	5	5	.96	10	57.5	42.5	4.8	1,622.8	162.3	56.2
300	3	7	.96	8.4	48.3	51.7	5.8	2,522.8	252.3	55.2
400	2	8	.96	8.2	47.2	52 8	5.85	2,794.8	279.5	55
500	2	8	.96	7.4	42.5	57.5	6.5	2,994.8	299.5	56

C.—50-VOLT, 16-C. P. LAMPS.

Hours burned.	No. of lamps.	No. of lamps broken.	Average current per lamp amperes.	Average c. p. per lamp.	Per cent. of c. p.	Per cent. loss of c. p.	Watts per candle.	Total lamp hours burned.	Lamp hours burned per light inst'd.	Average voltage on lamps.	Remarks. E. M. F. on lamps.
0	20	0	1.04	16.1	100	0	3.21	0			
100	20	0	.93	16.6	103		2.98	2,000	100	50.94	Max. 53.2 Min. 49.7
300	17	3	1.048	15	93.2	6.8	3.19	5,767	288.4	51.3	Max. 53.4 Min. 49.8
600	14	6	1.05	12.6	78.3	21.7	4.17	10,374	518.7	52.2	Max. 54 Min. 50.3
1,000	4	16	1.14	11	68.4	31.6	5.18	13,331.8	666.6	52	Max. 53.7 Min. 51.5
1,700	2	18	1.31	9.5	59.1	40.9	7.05	14,843.8	742.2	51.8	Max. 54 Min. 50

D.—50-VOLT, 16-C. P. LAMPS. VOLTAGE ABOUT 10 PER CENT. HIGH.

Hours burned.	No. of lamps.	No. of lamps broken.	Average current per lamp amperes	Average c. p. per lamp.	Per cent. of c. p.	Per cent. loss of c. p.	Watts per candle.	Total lamp hours burned.	Lamp hours burned per light inst'd.	Average voltage on lamps.
0	10	0	1 03	17.3	100	0	2.97	0		
100	10	0	1.00	15.18	88	12	3.3	1,000	100	56 4
200	7	3	1.00	12.8	74	26	3.9	1,838	183.8	56 2
300	†2	8	1.00	10.4	60.2	39.8	4.8	2,157	215.7	55.2

† Broke between 300 and 400 hours.

E.—50-VOLT, 16-C. P. LAMPS.

Hours burned.	No. of lamps.	No. of lamps broken.	Average current per lamp amperes.	Average c. p. per lamp.	Per cent. of c. p.	Per cent. loss of c. p.	Watts per candle.	Total lamp hours burned.	Lamp hours burned per light inst'd.	Average voltage on lamps.	Remarks. E. M. F. on lamps.
0	20	0	1.031	14.47	100	0	3.56	0			
100	20	0	.97	13.1	90.6	9.4	3.7	2,000	100	50.94	Max. 53.2 Min. 49.7
300	20	0	1.034	13 5	93.3	6.7	3.83	6,000	300	51.3	Max. 53.4 Min. 49.8
600	15	5	1.03	12.8	88.5	11.5	4.01	11,198	559.9	52.2	Max. 54 Min. 50 3
1,000	11	9	.98	11.1	76.7	23.3	4.41	16,525.8	826 3	52	Max. 53.7 Min. 51.5
1,700	7	13	1 01	9.85	68.1	31.9	5.12	21,832.8	1091.6	51.8	Max. 54 Min. 50

F.—50-VOLT, 16-C.P. LAMPS. VOLTAGE ABOUT 10 PER CENT. HIGH.

Hours burned.	No. of lamps.	No. of lamps broken.	Average current per lamp amperes.	Average c. p per lamp.	Per cent. of c. p.	Per cent. loss of c. p.	Watts per candle.	Total lamp hours burned.	Lamp hours burned per light'd.	Average voltage on lamps.
0	10	0	1.07	14.6	100	0	3.66	0		
100	10	0	1 06	14.34	98.3	1.7	3.69	1,000	100	56.4
200	7	3	1.06	13	89	11	4.07	1,838	183.8	56.2
300	6	4	1.06	11.2	76.7	23.3	4.73	2,448	244.8	55.2
400	6	4	1.06	9.85	67.5	32.5	5.38	3,048	304 8	55
500	6	4	1.06	9.06	62.2	37.8	5.85	3,068	361.8	56
600	2	8	1.06	7.6	52	49	6.97	4,060	406	56
800	1	9	1.06	7.5	51.4	48.6	7.06	4,428	442 8	56 2
900	1	9	1.06	7.4	50.7	49.3	7.16	4,528	452.8	56.5

G.—100-VOLT, 16-C. P. LAMPS

Hours burned.	No. of lamps.	No. of lamps broken.	Average current per lamp amperes.	Average c. p. per lamp.	Per cent. of c. p.	Per cent. loss of c. p.	Watts per candle.	Total lamp hours burned.	Lamp hours burned per light inst'd.	Average voltage on lamps.	Remarks. E. M. F. on lamps.
0	20	0	.463	12.0	100	0	3 82	0			
100	20	0	.45	10.67	88.2	11.8	4.21	2000.	100	101.88	Max. 106.4 Min. 99.4
300	19	1	.468	8.97	74.2	25.8	5.21	5870.	293.5	102.6	Max. 106 8 Min. 99.6
600	16	4	.47	7.6	63	37	6.18	11,601.	580	104.4	Max. 108 Min. 100.6
1,000	11	9	.45	6.27	51.8	48.2	7.17	16,133.5	806.6	104	Max. 107.4 Min. 103
1,700	8	12	.45	5.7	47.5	52.5	7.89	22,564.5	1128.2	1 3.6	Max. 108 Min. 100

H—50-VOLT, 16-C. P. LAMPS.

Hours burned.	No of lamps.	No. of lamps broken.	Average current per lamp, amperes.	Average c. p. per lamp.	Per cent. of c. p.	Per cent. loss of c. p.	Watts per candle.	Total lamp hours burned.	Lamp hours burned per light inst'd.	Average voltage on lamps.	Remarks. E. M. F. on lamps. Volts.
0	20	0	896	10.47	100	0	4.29	0			
100	15	5	.85	8.79	84	16	4.83	1,764	88.2	50.94	Max. 53.2 Min. 49.7
*300	13	7	.80	6.9	66	34	5.79	4,424	232.8	51.3	Max. 53.4 Min. 49.8
600	11	9	.79	6.4	61.2	38.8	6.17	8,094	426	52.2	Max. 54 Min. 50.3
1,000	10	10	.74	4.9	46.8	53.2	7.75	12,355	650	52	Max. 53.7 Min. 51.5
†1,700	6	14	.87	3.3	31.6	68.4	13 2	17,845 5	939.3	51.8	Max. 54 Min. 50

* One lamp broken accidentally.
† One lamp too dull to measure c. p.

I—100-VOLT, 16-C. P. LAMPS.

Hours burned.	No. of lamps.	No. of lamps broken.	Average current per lamp, amperes	Average c. p. per lamp.	Per cent. of c. p.	Per cent. loss of c. p.	Watts per candle.	Total lamp hours burned.	Lamp hours burned per light inst'd.	Average voltage on lamps.	Remarks. E. M. F. on lamps. Volts.
0	20	0	.517	15.4	100	0	3.35	0			
100	19	1	.475	12.6	81.8	18.2	3.77	1,915.	95.8	101.88	Max. 106.4 Min. 99 4
300	17	3	.484	11.7	76	24	4.13	5,567.	278.3	102.6	Max. 106 8 Min. 99.6
600	15	5	.49	9.6	62.4	37.6	5.1	10,475.5	523 8	104.4	Max. 108. Min. 100.6
1,000	12	8	.45	7.4	48.7	51.3	6.08	15,755.8	787.8	104	Max. 107.4 Min. 103
1,700	12	8	.46	5 8	37.7	62.3	7.93	24,155.8	1,207.8	103.6	Max. 108 Min. 100

J—50-VOLT, 16-C. P. LAMPS.

Hours burned.	No. of lamps.	No. of lamps broken.	Average current per lamp, amperes.	Average c. p. per lamp.	Per cent. of c. p.	Per cent. loss of c. p.	Watts per candle.	Total lamp hours burned.	Lamp hours burned per light inst'd.	Average voltage on lamps.	Remarks. E. M. F. on lamps.
0	20	0	1.01	15.9	100	0	3.16	0			
100	19	1	.96	15.2	95.6	4.4	3.15	1,954.5	97.8	50 94	Max. 53.2 Min. 49.7
300	16	4	1.013	13.9	87.5	12.5	3.65	5,389.5	268 5	51.3	Max. 53.4 Min. 49.8
600	12	8	1.02	12.2	77	23	4.18	9,583.5	479.2	52.2	Max. 54 Min. 50.3
1,000	8	12	.96	10.1	63.5	36.5	4.75	13,382.7	669.2	52	Max. 53.7 Min. 51.5
*1,700	6	14	.97	6.8	42.8	57.2	7.13	18,090.8	904.6	51.8	Max. 54 Min. 50

* C. p. of one lamp too low to measure.

K.—50 VOLT, 16-C. P. LAMPS. VOLTAGE ABOUT 10 PER CENT. HIGH.

Hours burned.	No. of lamps.	No. of lamps broken.	Average current per lamp, amperes.	Average c. p. per lamp.	Per cent. of c. p.	Per cent. loss of c. p.	Watts per candle.	Total lamp hours burned.	Lamp hours burned per light inst'd.	Average voltage on lamps.
0	10	0	1.00	14.5	100	0	3.46	0		
100	10	0	1.00	14.04	97	3	3.56	1,000	100	56.4
200	8	2	1.00	12	83	17	4.15	1,896	189.6	56.2
300	7	3	1.00	10.9	7522	24.8	4.58	2,630	263.	55.2
400	7	3	1.00	9.97	68.8	31.2	5.01	3,330	333.	55
500	6	4	1.00	9.3	64.2	35.8	5.37	3,934	395.4	56
600	5	5	1.00	7.9	54.5	45.5	6 33	4,525	452.5	56
800	2	8	1 00	7	48.3	51.7	7.14	5,157	515.7	56.2
900	2	8	1.00	7.3	50.4	49.6	6.85	5,357	535.7	56.5

L.—50 VOLT, 16 C. P. LAMPS.

Hours burned.	No. of lamps.	No. of lamps broken.	Average current per lamp, amperes.	Average c. p. per lamp, candles.	Per cent. of c. p.	Per cent. loss of c. p	Watts per candle	Total lamp hours burned.	Lamp hours burned for light inst'd.	Average voltage on lamps.	Remarks. E. M. F. on lamps.
0	20	0	1.032	15.94	100	0	3.23				
100	19	1	.98	12.5	78.6	21.4	3.92	1,914 8	95.7	50.91	Max. 53 2 Min 49.7
300	18	2	1.026	12	75.3	24.7	4.27	5,654.8	282.7	51.3	Max. 53.4 Min. 49.8
600	17	3	1.03	11.8	74 1	25.9	4.36	10,943.8	574.1	52.2	Max 54. Min. 50.3
1,000	12	8	1	10.03	66.5	33.5	4.85	17,054 8	852.8	52.	Max. 53 7 Min. 51.5
1,700	1	10	1.03	9.6	60.3	39.7	5.37	24,440.8	1,222.1	51.8	Max. 54. Min. 50.

N.—50-VOLT, 16-C. P. LAMPS. VOLTAGE ABOUT 10 PER CENT. HIGH.

Hours burned.	No. of lamps.	No. of lamps out.	Average current per lamp, amperes.	Average c. p. per lamp.	Per cent. of c. p.	Per cent. loss of c. p.	Watts per candle.	Total lamp hours burned.	Lamp hours burned per light inst'd.	Average voltage on lamps.
0	10	0	1.00	14.9	100	0	3.37	0		
100	9	1	1.00	13.3	89.3	10.7	3.75	957	95.7	56.4
200	6	4	1.00	11.3	76	24	4.42	1,774	177.4	56.2
300	4	6	1.00	9.8	65.8	34.2	5.10	2,244	224.4	55.2
400	3	7	1.00	8.3	55.7	44.3	6.02	2,579	257.9	55
500	3	7	1.00	8.23	55.3	44.7	6.07	2,579	287 9	56
600	1	9	1.00	7.7	51.7	48.3	6.50	3,050	305.6	56

O—50-VOLT, 16-C. P. LAMPS.

Hours burned.	No. of lamps.	No. of lamps broken.	Average current per lamp, amperes.	Average c. p. per lamp candles.	Per cent. of c. p.	Per cent. loss of c. p.	Watts per candle	Total lamp hours burned.	Lamp hours burned per light inst'd	Average voltage on lamps.	Remark. E. M. F. on lamps.
0	20	0	1.017	15.45	100	0	3.29				
100	16	4	1.09	15.5	100.3		3.51	1,772.7	88.64	50 94	Max. 53.2 Min. 49.7
*300	13	7	.989	13.6	87.8	12.2	3.63	4,838	241.9	51.3	Max. 53.4 Min. 49.8
600	7	11	.99	12.04	77.9	22.1	4.11	7,071	366	52.2	Max. 54. Min. 50.3
1,000	1	17	.99	9.7	62.8	37.2	5.11	8,928.5	469	52	Max. 53.7 Min. 51.5
†1,700	1	17						9,628.5	508	51.8	Max. 54 Min. 50

* Two lamps broken by accident.
† Discarded.

P.—50-VOLT, 16-C. P. LAMPS.

Hours burned.	No. of lamps.	No. of lamps broken.	Avge current per lamp, amperes.	Average c. p. per lamp.	Per cent. of c. p.	Per cent. loss of c. p.	Watts per candle.	Total lamp hours burned.	Lamp hours burned per light inst'd.	Average voltage on lamps.	Remarks. E. M. F. on lamps.
0	20	0	.996	15.63	100	0	3.12	0			
100	17	3	.97	15.2	97.3	2.7	3.18	1,784.(	89.23	50.94	Max. 53.2 Min. 49.7
*300	14	6	.997	12.8	81.9	18.1	3.89	5,079	253.9	51.3	Max. 53.4 Min. 49.8
6 0	8	12	1.00	11.6	74.2	25.8	4.31	8,629	431.5	52.2	Max. 54 Min. 50.3
1,000	2	18	1.00	10.25	65.7	34.3	4.87	10,827.8	541.4	52	Ma c. 53.7 Min. 51.5
*								13,618.5	680.9	51.8	Max. 54 Min. 50

* Lamps all broken.

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Chronological History of Electricity—Part II.—1800-1820.

BY P. F. MOTTELAY.

LINDERS (Matthew), a very able navigator and captain in the English merchant service, sails in the bark Investigator, for the purpose of circumnavigating and exploring New Holland. During this memorable but unfortunate voyage he carefully observed the cause of errors in the variation of the magnetic needle as depending on the direction in azimuth of the ship's head, having often noticed, as a writer in the English *Quarterly Review* expresses it (vol. cxviii., p. 343), that the direction of the compass needle frequently wandered from that which the known variation due to the geographical position of the ship assigned to it. To correct those disturbances he suggested placing aft of the compass a vertical bar of soft iron, whose upper end, having like magnetism as the imaginary mass in the ship's head, would, in acting on the opposite pole of the compass needle, correct its disturbances.

Flinders had, during the year 1795, made observations similar to those recorded by the astronomer Bayly, who had sailed with Captain Cook during his last two voyages, but it was not until his return from the unfortunate expedition above alluded to that he recorded his investigations for the benefit of navigators.[1]

A. D. 1801.——Gautherot (Nicholas), able French chemist (1753–1803), while making experiments upon electrolysis, discovers that when a current has passed through two plates or wires of the same metal in dilute sulphuric acid, a secondary, reverse or polarization current is obtainable after disconnecting the battery. This was the first step in the storage of electricity—the germ of the secondary battery—and an account is given of it in the *Philosophical Magazine*, vol. xxiv., pp. 185–186, which contains a report of the proceedings before the Galvanic Society of Paris. Gautherot says that the results he obtained should become "the source or basis of several other experiments, and concur more than any other to the discovery of the theory of this new branch of physics."

In this same year Gautherot observed the power of adhesion of the two wires in contact with the upper and lower ends of the pile, a report upon which appears at p. 209, vol. xxxix, of the *Annales de Chimie*, while a full account of his observations on the subject forms the substance of a separate work printed in London during the year 1828.

The French physicist, C. J. Lehot, makes allusion to the last named discovery in the following words, at p. 4 of his pamphlet entitled "Observations sur le Galvanisme et le Magnetisme":

> It has long been known that the two wires which terminate a pile attract one another, and, after contact, adhere like two magnets This attraction between the two wires, one of which receives, and the other loses, the galvanic fluid, differs essentially from electrical attraction, as Ritter observed, since it is not followed by a repulsion after contact, but continues as long as the chain is closed.

Mr. J. J. Fahie, who also quotes this passage, says:

> The discovery in question seems to have been made independently, and at about the same time by Gautherot (*Philosophical Magazine* or *Annals* for 1828, vol. iv., p. 458), by P. S. Laplace, and by J. B. Biot (*Journal de Physique et de Chimie*, for 1801, vol. liii., p. 266). The latter made the further very acute observation that, if the wires be attached to plates of metal, and these plates be approached by their edges, they will attract one another; while if approached by their faces no action whatever takes place. For other interesting experiments of this kind see Nicholson's *Journal* for 1804, vol. vii., p. 304.

Previous to the aforesaid discoveries on the 12th Brumaire, An IX., (Nov., 1800), Gautherot had published his refutation of Volta's contact theory, through the Paris "Société Philotechnique," and it is to be found recorded at page 471, vol. i., of the "Mémoires des Sociétés Savantes et Litteraires de la Republique Francaise." He subsequently devoted so much careful attention to galvanic researches that Messrs. A. F. de Fourcroy and L. N. Vauquelin made a special and very favorable report upon the five important memoirs containing the results of his many observations to the French Institute on the 21st Fructidor, d. 1802.

The first memoir gives the whole theory and practice of the various kinds of conductors, and describes an apparatus devised by Gautherot to ascertain the conducting powers of different natural, solid, liquid and even gaseous bodies.[2] He enters into full details as to the effects of the voltaic pile in many experiments made upon himself, and draws consequences which seem to disprove the identity of the electric and the galvanic fluids.

The second memoir treats of the galvanic properties of charcoal, and shows that it is not so perfect a conductor as are metallic substances.

In the third memoir he makes known his discovery that charcoal and zinc form a galvanic apparatus which will produce shocks, the decomposition of water, etc. He observes "that in the decomposition of water, charcoal decomposes that fluid in the same way with non-oxydable metals; or, in other words, that when two pieces of charcoal are employed for this purpose, one of them disengages the hydrogen gas, and the other the oxygen." Another peculiarity observed by him was "that when the portions of charcoal touch each other in the water, its decomposition is not stopped on that account, as happens when metallic substances are brought in contact under the same circumstances. Indeed, if to bring more immediately together, one of the pieces of charcoal be cut in a furcated shape, this does not become an obstacle to the decomposition of the water." According to this mode of reasoning, charcoal is not so powerful a conductor as the fluid upon which it acts.

The fourth memoir treats further of different kinds of conductors, and of various modes of constructing galvanic columns.

In the fifth and last memoir Gautherot relates his important discovery that an effective galvanic apparatus can be made without metals. He constructed one of forty layers of charcoal and plumbago, which communicated a strong and pungent taste, accompanied by the galvanic flash of light, and which finally produced the decomposition of water, the charcoal side disengaging the hydrogen gas. This latter circumstance, he observes, removed every doubt of the influence of metals, even of that of the iron which might have been contained in the plumbago; since, supposing the metal to have existed there, the hydrogen gas would have been disengaged on the side of the plumbago in the same manner as it is disengaged in batteries constructed with charcoal and iron.[3]

During the month of March, 1803, he read before the "Institut National" a memoir entitled "Recherches, etc." (researches upon the causes which develop electricity in the galvanic apparatus). This appeared in the *Journal de Physique*, vol. lvi., p. 429.[4]

A. D. 1801.——Robertson (Etienne Gaspard), a very capable French experimentalist and one of the founders of the Paris Galvanic Society, who has already been alluded to in the article relating to Sir Humphry Davy, writes a memoir, "Experiences nouvelles sur le fluide galvanique," which was read before the Institute on the 11th Fructidor, An VIII., and which appeared in the *Annales de Chimie* (vol. xxxvii., p. 132), as well as in his "Mémoires Recreatifs, Scientifiques, etc.," published in Paris during 1840, three years after Robertson's death.

The latter states that as he was delivering a lecture on the 9th Vendémaire, An IX., during which he alluded to differences which he found to exist between the galvanic and electric fluids, he was interrupted by Prof. Brugnatelli, who stated that Mr. Volta, who was then present, would be glad of an opportunity to correct the wrong impressions the lecturer labored under. Volta called upon him early the day following and brought a live frog as well as apparatus, with which they experimented a long while, and the results of which brought Robertson completely over to the views of the Italian scientist. Volta frequently repeated his visits, which led to the development of a lasting friendship between the two. They visited together all the prominent scientific bodies, such as l'Ecole de Médicine, l'Ecole Polytechnique, etc., but found to their great astonishment that Robertson was the only one in Paris who had as yet given the new discovery any serious attention. At pages 250–253, vol. i., of his "Mémoires, etc.," will be found a full account of the above as well as of the very indifferent reception first given them by the celebrated Prof. Charles.

Robertson adds (page 256 of last named work) that he was asked by Volta to witness the latter's notable experiments made before the members of the National Institute of France, Nov. 16, 18, 20, 1800, and already alluded to at A. D. 1775. The sessions of that body were being held at the time in the Palace of the Louvre, and the excitement caused by the meetings was so great that all the approaches were guarded by soldiery. Mr. Biot and Mr. Robertson arrived quite late on the second day and found it necessary to obtain the permission of a superior officer before they could enter. After Prof. Volta had explained his theory and alluded to the identity of electricity and galvanism, he announced that Robertson had first illustrated the fact, and he asked him to repeat his original experiment, which the latter did after the necessary hydrogen gas had been procured from the neighboring cabinet of Prof. Charles.

Robertson is also the author of several other interesting memoirs on the electrophorus, the improved "couroune de tasses" and "acide galvanique" which can be found respectively in vol. xxxvii. of *Journal de Physique* and in the *Journal de Paris* for the year 1800.[5]

A. D. 1801.——Gerboin (A. C.), Professor at the Medical School at Strasbourg, is the first to report upon the peculiar agitation of mercury when the voltaic current passes through it.

He states, in his "Recherches expérimentales sur un nouveau mode de l'action electrique" (Strasbourg, 1808), that his many researches were instigated by the observation he had made during the winter of 1798, while in company with some friends watching a child play with a hollow wooden ball. The Italian physicist, Abbate Fortis (1740-1803), who wrote several works on natural philosophy, but who is best known by his "Viaggio di Dalmazia," had already announced that a pyritical cube suspended by a thread held between the thumb and index finger would immediately, without any movement of the fingers, assume a circular motion upon being approached by another body. The "Morgenblatt" of Turbingen and the French "Archives Littéraires" rendered in 1807 a very complete account of Ritter's researches upon the Fortis pendulum, and Mr. N. Meissas states, at pages 181-187 of his "Nouveau Elements de Physique," Paris, 1838, that he repeated the experiment of Ritter and of his friend Gerboin and observed many curious results, which he embodied in a communication during the month of April, 1826, to Mr. Ampère, who looked into Mr. Meissas' work in company with Mr. Becquerel, also a member of the French Institute.

In his (17) experiments, Gerboin employed a tube bent in U form, filled half full of mercury, which later was covered with a stratum of water, and he placed therein the wires connecting with a pile. The surface of the mercury beneath the negative pole was slightly oxidized, but the surface under the positive point moved so violently as to cause small bodies placed within to be thrown outward upon the surface of the tube. These bodies moved in a contrary direction, *i. e*, from the circumference toward the interior, if the positive pole was made to touch the liquid metal.[6]

A. D. 1801.——Trommsdorff (Johann Bartholomäus), German chemist and pharmacist, who became professor of physics and chemistry in the University of Erfurt, discovers that by employing large sized plates in galvanic batteries he can produce the combustion of fine wires and of thin leaves of metal.

After having obtained very strong shocks and large sparks, and effected the decomposition of water, etc., with his first pile consisting of 180 discs of copper, zinc and wet cardboard, he experimented with very thin leaves of the following metals, and found them to burn as follows: Gold, with a bright white light; silver, with a blue light; yellow copper, with a reddish blue light; red copper, with an emerald blue flame; zinc, with a bluish white flame; tin, with a reddish white light, etc. When oxidizing the noble or perfect metals, gold, silver, platinum, in hollow glass spheres, he found them to melt so thoroughly as to completely line the sides of the latter.

Mr. Trommsdorff afterward constructed a pile of nearly 600 discs and did not doubt but with a larger apparatus he could in like manner consume very thick plates. It was while carrying on subsequent experiments that MM. Fourcroy, Vauquelin and Thénard ascertained the fact that metals were more effectively deflagrated by piles with large plates than by piles having a great many plates of smaller surfaces.

In a letter dated Erfurt, March 16, 1801, Trommsdorff alludes to the galvanic decomposition of water spoken of at page 98 of the "Archives du Nord pour la Physique et la Médicine," published at Copenhagen, and expresses doubts as to the correctness of the conclusions therein pointed out by Pfaff and Ritter.[7]

A. D. 1801——Libes (Antoine), Professor of Natural Philosophy at the Collège de Beziers and at the Paris Ecole Normale and Lycée Charlemagne, publishes in three volumes, at Paris, his "Traité élémentaire de Physique," which had been preceded by his "Théorie de électricité, etc.," and was followed by a valuable "Dictionaire de Physique" in 1860. (C. P. V. Delaunay "Manual, etc.," Paris, 1809.)

In his "Traité," Prof. Libes dispels the previous generally accepted belief as to the production of electricity by pressure. Experiments made by Æpinus and by Hauy had shown that such minerals as developed positive electricity by friction likewise exhibited the same electricity by pressure, and that those furnishing resinous or negative electricity by pressure developed the same electricity by friction. From this fact was drawn the inference that friction is produced in minerals through pressure and that the phenomena in question are simply the result of excitation by friction.

It is known that varnished silk (*taffetas gommé*) acquires resinous electricity by ordinary friction, but Libes found the means of causing it to develop vitreous or positive electricity. This is shown when a metallic disc insulated by a glass handle is pressed upon the silk; the latter will be found to have acquired positive electricity while the disc will develop resinous or negative electricity. If, on the other hand, the disc is rubbed or rolled upon the silk so as to produce friction, the silk acquires resinous electricity and the disc vitreous or positive electricity. Another curious fact is that if a glass plate be substituted for the disc the silk again acquires vitreous electricity and the glass resinous electricity, that is to say, they both develop contrary electricities to that furnished through ordinary rubbing [8]

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[1] See "Encyclopædia Britannica," 1856, vol. x., p. 295, and article "Australia," vol. iv., pp. 253, 254; "English Cyclopedia" (Biography), vol. ii., pp. 933-935; *Sci. Am. Supp.*, No. 534, p. 8,526; William Walker, "The Magnetism of Ships," London, 1833, pp. 21-23; "Abstracts of Papers of the *Phil. Trans.*, 1800-1830," p. 187; *Phil. Trans.* for 1805; John Farrar, "Elem. of Elect.," 1826, p. 381.

[2] Izarn, "Manuel du Galvanisme," 1804, pp. 56-60,

[3] Izarn, "Manuel du Galvanisme," 1804, p. 177.

[4] See "Biographie Générale," vol. xix., p. 691; Larousse, "Dict. Univ.," vol. viii., p. 1,089; Giuseppe (Joseph) Izarn, "Manuel du Galvanisme," Paris, An xii., 1801, section vi., pp. 95, 250-54; *Mem. des Soc. Savantes*, etc., vol. i., pp. 164, 168; P. Sue, aîné, "Hist. du Galvanisme," Paris, An x., 1802, vol. ii., pp. 191, 196-203, 213, 214, 316; Alglave et Boulard, *Lumière Electrique*, Paris, 1882, p. 219; *Poggendorff*, vol. i., p. 857; "Extrait d'une lettre de Brugnatelli, etc.," Bruxelles, 1802; Van Mons, *Journal de Chimie*, vol. ii., p. 216

[5] See "Recueil de Actes de la Soc. de Lyon," tome ii., p. 370,

[6] See the observations of Mr. Erman, of the Berlin Academy of Sciences, upon Mr. Gerboin's experiments related in the *Annales de Chimie*, tome lxxvii., p. 32. See, also *Annales de Chimie*, tome xli., pp. 196, 197, *Mem. des Soc. Sav. et Lit.*, vol. ii., p. 199; Dr. Gore, "El. Metal," 1877, p. 3; De la Rive, "Treatise on Electricity," 1856, vol. ii., p. 433; Gmelin's Chemistry, vol. i., p. 487.

[7] See "Encycl. Metrop." (Galvanism), vol. iv., p. 221; "Roy. Soc. Sci. Papers," vol. vi., pp. 45-52; *Poggendorff*, vol. ii., pp. 1,136, 1,137; C. H. Wilkinson, "Elem. of Galv.," London, 1804, vol. ii., pp. 134-136; J. S. Ersch, "Handbuch, etc.," p. 119; L. F. F. Crell, "Chemische Annalen," for 1801, 4e Cah. p. 337; J. B. Van Mons, *Journal de Chimie*, vol. i., p. 41; Larousse, "Dict. Univ.," vol. xv., p. 535.

[8] See Larousse, "Dict. Univ.," vol. x., p. 475; *Poggendorff*, vol. i., pp. 1,449, 1,450; Volpicelli, "Sul cognito fenomeno. . . ." Roma, 1859; Haüy, "Traité Elémentaire de Physique," Paris, 1806, vol. i., pp. 371, 372; A. C. Becquerel, "Expériences . . . par la pression," Paris, 1823; "Catal. of Sci. Papers of Roy. Soc.," vol. iv., p. 5; Thos. Thomson, "An outline of the sciences of heat and electricity," London and Edinburgh, 1830, p. 482; Dove, p. 229; "Encycl. Britannica," vol. viii., 1855, p. 563; *Annales de Chimie et de Physique*, vol. xxii., p. 5; *Phil. Mag.*, vol. lxii., pp. 204, 263,

On the Physics of the Voltaic Arc.*

BY PROF. SILVANUS THOMPSON, F. R. S.

What I have to say relates to the electromotive force of the voltaic arc. If you measure with a voltmeter the difference of potential between the two electrodes of the arc, you find, when the arc is steady, the total voltage so observed is something over 40 volts, and it is known that part of this varies with the length of the arc and the current sent through the arc, and that part is practically independent of either the current or the length. There is a constant part and another part, which varies nearly directly as the length of the arc when the current is constant, and nearly inversely as the current when the length of the arc is constant. A useful approximate formula for the steady arc is $v = a + b\frac{l}{i}$ where a and b are constants, l the length of the arc, and i the current. The constant a varies between 35 and 39 volts; while when l is given in millimetres and i in ampères the constant b has values between 8 and 18.

Now, this constant part of the voltage, which is independent of the strength of the current for an invariable length, and independent of the length of the arc for an invariable current, is sometimes called the apparent back electromotive force of the arc. The arc acts as though it were the seat of a back electromotive force. I am not saying there is actually one, only that it acts as though there were. It is possible to account for the thing equally well by saying that there is somewhere in the arc a resistance which proportions itself always inversely to the current. Now, how can any resistance proportion itself so to the current? It can only do so in the following way: If there is at any one surface of the arc a something equivalent to a transition resistance, then if that varies inversely with the area over which it takes place, and if the area over which it takes place is proportional to the current, then you might have something of the kind to explain this. Some years ago I explored the question of the seat of this supposed back electromotive force, and established, by means of the measurements made with a third movable electrode, that the seat of this electromotive force was at the crater. This was when taking the ordinary method of producing the arc between two carbon electrodes, an upper and a lower. I explored where the great drop of potential, 35 to 39 volts, occurred. I found that the drop of potential along the arc only amounted to a few volts, and where the great drop took place was at the surface of the positive electrode or crater. This is where most of the work of the arc is done. That being settled as to position, the next question was, what was the physical process going on there which would require such absorption of energy which made this great fall of voltage, and I could only account for it at the time by supposing that the volatilization of the carbon required it. I was led to this by various reasons, one being Captain Abney's discovery that the surface of the crater is always of an equal intensity; the brilliancy for the same quality of carbon per square centimetre was always the same. I was led by that to think it must be simply a question of volatilization.

Quite recently, however, Mr. Crookes has made the observation that the flaming discharges produced by alternating electric currents at very high rates of alternation and very high voltage are really endothermic flames of nitrogen and oxygen; in other words, those flaming discharges are simply flames which, instead of giving out heat, absorb heat. Now, in the voltaic arc, as produced in air, something of this kind may occur. There must be a temperature high enough to bring about for the time being the combination of nitrogen and oxygen. We know from Prof. Dewar that such combinations are going on. The question consequently occurred to me whether this had anything to do with the voltage of the arc; and within the last month I have made a number of experiments to put this particular point to the test. A number of experiments were made in my laboratory to test whether the possible combustion of nitrogen and oxygen together had anything to do with the electromotive forces there observed. We did this by surrounding the arc by a glass tube, into which we could introduce a number of gases, say oxygen, nitrogen, carbonic di-oxide, hydrogen, and so forth. Using always short arcs, and waiting until the current was adjusted to 10 amperes and the arc adjusted to the exact length, we found it does not really make one volt difference. The back electromotive force, or whatever it is, is independent of the surrounding atmosphere.

Incidentally we have observed several effects, namely, that when chlorine and carbonic oxide are used as the atmosphere in which to produce the arc, the crater takes a quite different form from that of the usual arc. The carbon is flattened over the end instead of hollowed, and the negative carbon is also a very obtuse cone. Also when the arc is made with hydrocarbon or coal gas around it the crater is formed, but the edges do not burn away as they do when the arc is made in air. Consequently, there is a regular sooty deposit all round, and the arc is formed up inside a sort of cage. When the arc is made in oxygen, both the carbons burn away very fast. Instead of their ordinary consumption there is an extraordinary consumption which burns them down conically a long way. We have also observed in bringing these gases to the outside of the arc it is necessary that they be introduced gently, without violent draughts, because with even a gentle current of gas the voltage is altered. By blowing on an ordinary arc in air the voltage has been made to rise to as much as 75 volts.

The experiments were conducted by Mr. Eustace Thomas, one of the demonstrators, and by Mr. Portheim, one of my students, to both of whom my thanks are given. There still remains much to do in measuring with exactitude the small variations which may be due to endothermic actions.

*A paper read before the British Association, in Section A, Edinburgh, August, 1892.

Electro-Metallurgy.—XIII.*

BY F. M. F. CAZIN.

Second Part.—Electro-Metallurgical Practice.

1.—COPPER (CONTINUED).

As a direct result of the action of these different metals and of other matter, when present in the electrolytic apparatus or bath, certain precautionary measures become necessary in order to obtain good results in electrolytic copper refining.

These precautionary measures, all of which are conditional to successful electrolytic copper refining, may be enumerated as follows:

1. The testing at regular intervals of the composition of the electrolyte: a) as to copper percentage, (b) as to percentage in free acid, and the restoration of a normal composition (5 per cent. of free acid, 3.8 per cent. of copper) by adding to the bath what is wanting either in a well regulated continuity or at intervals and under control of tests.

2. The maintaining of a uniform composition of the electrolyte in all the different parts of the apparatus, which is best attained by circulation of the liquid, and to which the arrangement of electrodes (vertical or horizontal) is largely contributive.

3. The absolute prevention of turbidness in the bath. When circulation is resorted to, the liquid must be made transparent before it is returned to the bath.

4. The elimination from the bath of both the mud and the resulting foreign compounds in solution that are not required in the electrolytic action.

Such elimination can be effected in alternate or continuous action and in connection with the circulation of the solution.

The uniformity and a desirable quality of electrolytic action depends absolutely on such elimination.

The less time the mud falling from the anodes (or out of the electrolyte by dissolved components becoming indissoluble) is kept in contact with the electrolyte, the less disturbing secondary chemical action between such mud and the electrolyte will take place. The form of vessel, serving as electrolytic bath, that causes the mud to collect within a comparatively small space and which form will thus permit a continuous evacuation of the forming mud without causing turbidness is therefore preferable to any other form.

A circulation of the electrolyte, by which the natural movement of the depositing particles forming the mud is counteracted or disturbed, is vicious and will lead to many disappointments, unless the cathion be absolutely protected by special provision against the association therewith of any mud particles.

The cathode faces must meet with a clear transparent solution only in order to produce a chemically pure cathion, and even this is not all that is required in regard to the qualities of the electrolyte. The clear and transparent solution may contain an excess of other compounds, which excess vitiates either the chemical or the physical qualities of the cathion or even both. The copper cathion may thus be discolored and made brittle.

5. To continuously supervise the electric circuit in order to keep the electrodes uninterruptedly in their proper electric connection.

6. The maintaining of the normal distances between electrodes, which in no case should be in excess of five centimetres (0.05 metre), but may be considerably less, as long as the electrolyte enters everywhere between them.

7. The prevention of anodes falling to pieces, or of parts thereof losing connection with the electric circuit, or of such parts acting as conductors between anode and cathode.

8. The maintaining of clear electrode faces. This may be achieved either by alternate interruption of the entire operation for the purpose of cleaning or by mechanical continuous sweeping or brushing of anodes and even of cathodes, where the cathion is not wanted in cohesive plates.

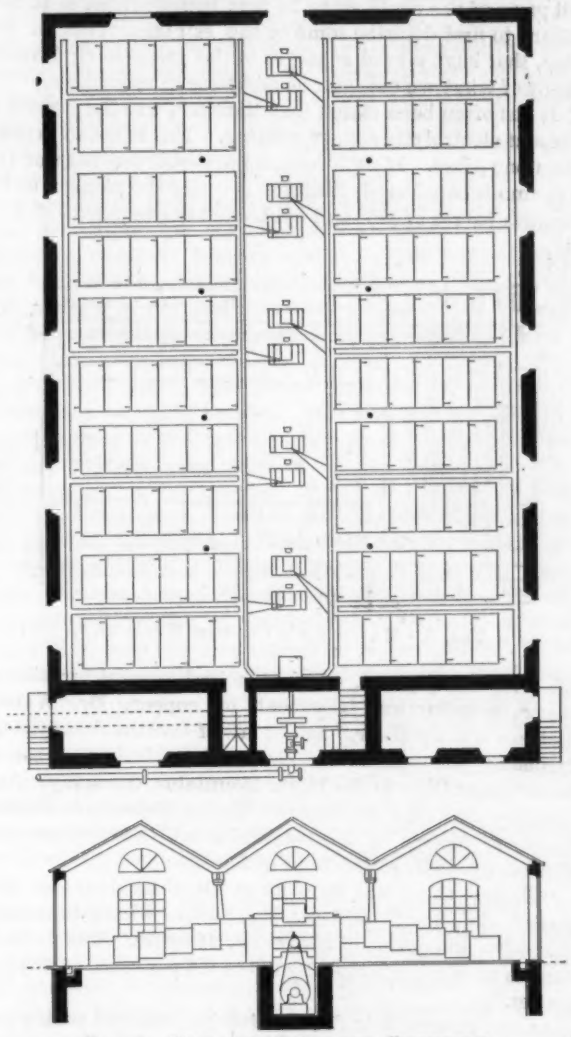


FIG. 1.—MARCHESE'S COPPER REFINERY.

Mechanical means should be provided in all cases for lifting the electrodes out of the bath in a body and for removing and interchanging them without loss of time in the utilization of bath action, that is by substituting exhausted anodes in a body. Much of the advantages attributed to the horizontal arrangement of electrodes is neutralized or lost by the greater difficulty attending their interchange, as compared with vertical electrodes and with the easy mechanical handling of them. Such mechanical provisions for handling the electrodes in a body and for their cleaning or interchanging away from the bath promotes necessary cleanliness, correct action and reduction of expenditure for labor and material.

9. The maintaining of normal electric conditions by adquate series or parallel connection of baths and by adaptation of quantity of electrode faces toboth the value (area) of current and the desired physical qualities of the cathion.

In this regard it is of highest importance to know that working with electric pressure insufficient to perfect the disengagements of CuO from SO_3, as well as of Cu from O, leaves by practical experience an incomplete disengagement of Cu and O, and results in the presence of copper oxide (Cu_2O) in the cathion.

Excess of current relative to face of electrodes is apt to cause brittleness and excrescences of cathion matter, and shows the same effects that result from a conductor, the conductivity of which is inadequate to the electric current in the circuit of which it lies.

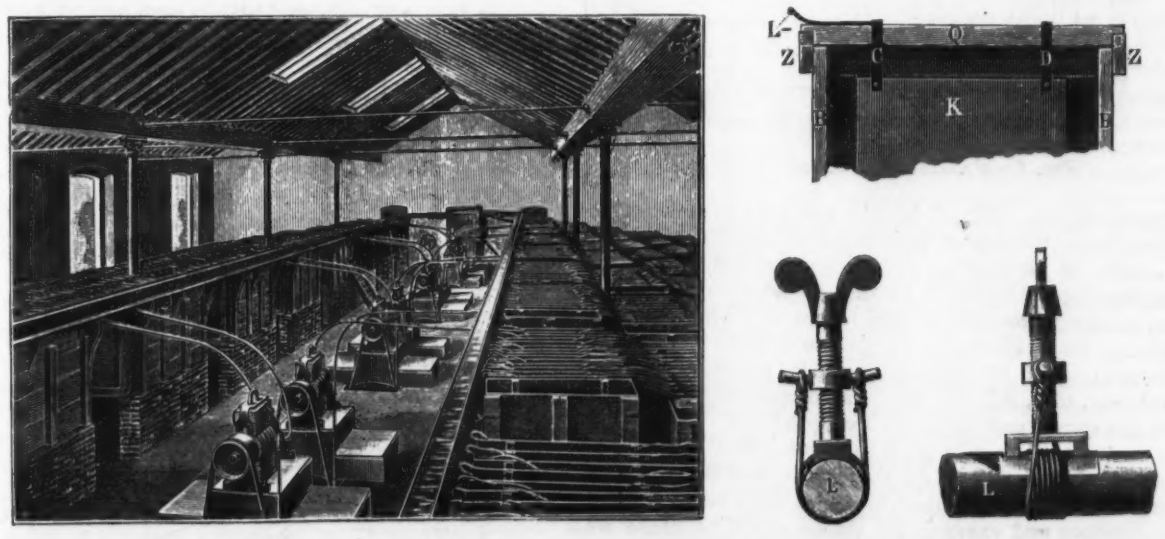


FIG. 2.—INTERIOR VIEW AND DETAILS OF MARCHESE'S COPPER REFINERY.

*For the twelfth section of this series see THE ELECTRICAL WORLD of Sept. 10, 1892.

In continued observation in using an electrolyte as described (5 per cent. free acid, 3.8 per cent. copper) 15 to 50 ampères per square metre have been found to be applicable and to produce normal qualities of cathion, the determination of the precise requirement being a matter of special conditions of operation and of qualities of cathion desired.

APPARATUS.

In order to arrive at an intelligent description of a perfect apparatus for electrolytic copper refining, as it is constructed by adaptation to our present theoretical knowledge and to the results of practical observation in such refining in all parts of the world since its first introduction, it is necessary to first describe some of the establishments in this line, that have served as stages in the progressive development of what we consider as adequate in these days.

It has often been stated that Marchese was the pioneer of present electrolytic copper refining. This is not so in more than one sense. If such refining without the help of the dynamo is considered, Elkinton is really the pioneer, as his English patent of 1865 and his United States patent of Feb.

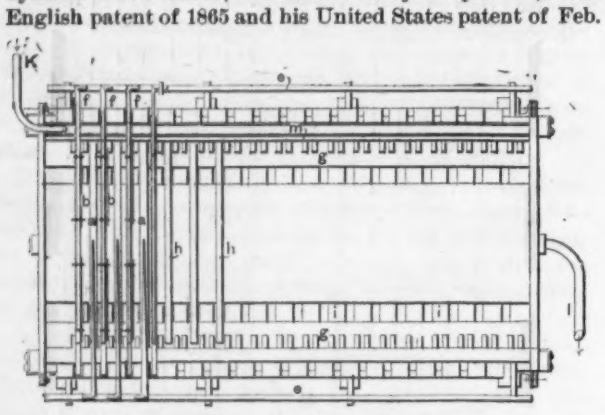


FIG. 3.—MARCHESE'S COPPER REFINERY.

22, 1870, amply prove. And of actual present practice in electro-metallurgical treatment of copper, Dr. Werner Siemens is the pioneer. In the fall of 1878 the first dynamo furnishing the current for copper electrolysis was set in operation at Oker in the Hartz Mountains, Germany. And the chief electrical engineer of Messrs. Siemens & Halske, Froelich, reports on the establishment (*Electrotechnische Zeitschrift*, 1884, p. 466, etc.) as follows:

"To-day there are at work at Oker six dynamos altogether, viz., five C_1 and one C_{1s}, each of which disengages 250 to 300 kilograms of copper per 24 hours. The material used as anodes contains only 0.3 to 0.5 per cent. of foreign matter."

At the present date fire refining has attained such a perfection and quality of product that the electrolytic handling of fire refined material as the one treated at that time at Oker has lost its object. And the knowledge acquired, that with a low resistance material containing as high as 40 per cent. of iron, sulphur, etc., and as low as 60 per cent. or even less of copper, can be refined in one electrolytic operation, has given to present practice a different direction, although it is surrounded by greatly increased difficulties. It is in the practice last referred to that

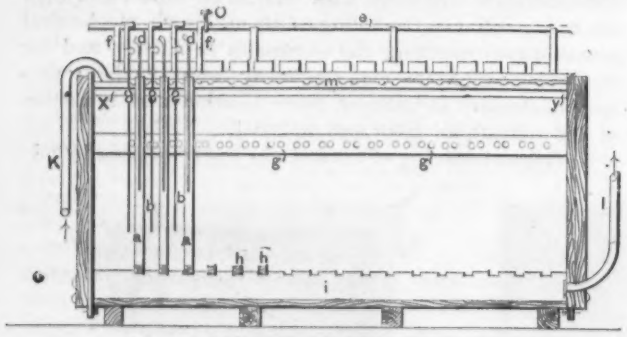


FIG. 4.—MARCHESE'S COPPER REFINERY.

Marchese has achieved his victories after many struggles. His first establishment was erected at Casarza, near Sestri-Levant, in Lombardy, Italy. Subsequently he erected another establishment at Genna, to which establishment an honorary premium of 5,000 francs was awarded at the International Electrical Exposition at Paris. It is from a description of this establishment, in *Lumière Electrique*, vol. xiv., 1884, No. 42, that the accompanying illustrations of this second establishment are reproduced.

It may not be out of place to mention that Marchese has been made to suffer, as all progressive and inventive promoters of other technical branches have been, from the pretensions and exaggerated claims raised by those who were employed to continue the operation of establishments set going by the inventor. A slight modification introduced into such operation, the necessary result of continued practice, would cause an outcry on the part of the lesser capacities or menials, to the effect that Marchese's process be discontinued and their own and superior method be now followed. Such presumptions are of the most common occurrence in the history of technical progress, and the struggle for prominence has deteriorated technical competition to something almost contemptible to behold in its tendency to detract from the merit of the meritorious. And in symmetry therewith is the "much ado about nothing," with which unessential improvements are heralded as great progressive steps.

After starting the Genna establishment Marchese constructed and operated a similar establishment at Stollberg (Prussian Westphalia), where a material was used for casting the anodes that contained Cu, 17.20 per cent.; Pb, 23.70 per cent.; S, 21.03 per cent.; Fe, 29.18 per cent.; SiO, 0.88 per cent.; Ag, 0.0623 per cent.; and which probably examplifies

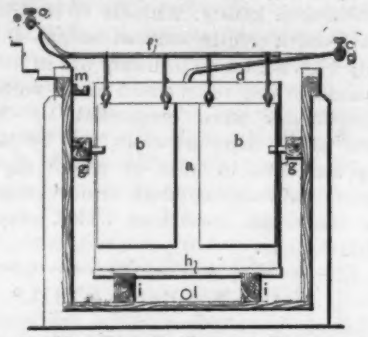


FIG. 5.—MARCHESE'S COPPER REFINERY.

the extreme line of applicability of the process of direct electrolytic copper refining from alloys and mattes.

Fig. 1 represents the plan and elevation, and Fig. 2 the inner view and details of electrode connections of Marchese's copper refineries.

The absence of all mechanical appliances for raising the electrodes from the baths is what first strikes the attention in the inner view as here represented.

Fig. 3 represents the single bath in plan; Fig. 4 represents the single bath in transverse elevation, and Fig. 5 represents the single cell in longitudinal elevation.

A Portable Instrument for Measuring Magnetic Fields, with Some Observations on the Strength of the Stray Fields of Dynamos.*

BY EDWIN EDSER AND HERBERT STANSFIELD.

This instrument was constructed for the purpose of giving direct readings for the strength of magnetic fields, such as are found in the neighborhood of dynamos; thus avoiding the inconveniences attending the ballistic method. Portability, a considerable range, and a fair degree of accuracy were the qualities sought. The instrument, as now constructed, while satisfying the first of these conditions, may be used to measure any field from one line per centimetre upward, with an error of only about two per cent.; the only accessories required being a dry cell and a resistance box.

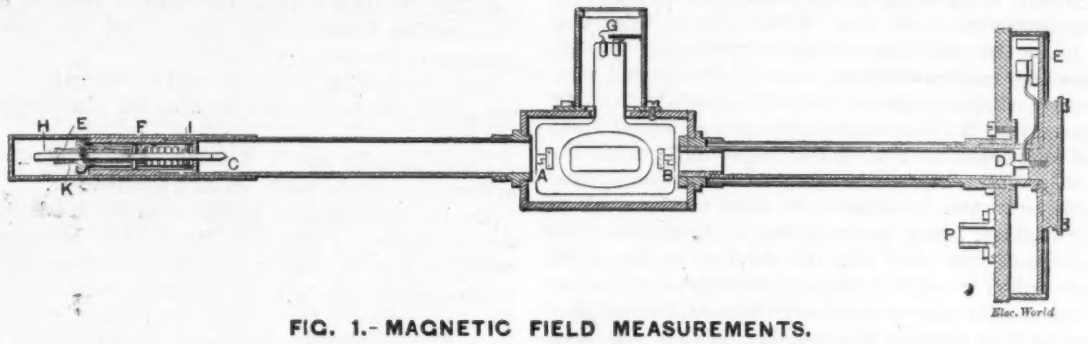
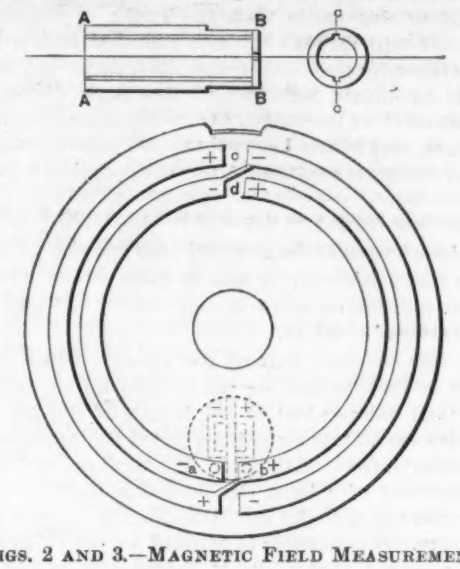


FIG. 1.—MAGNETIC FIELD MEASUREMENTS.

In principle it is the inversion of the D'Arsonval galvanometer; the torsion necessary to restore a coil, through which a constant current circulates, to its normal position, parallel to the direction of the lines of force, furnishing readings proportional to the field at the position of the coil.†

A diagram of the instrument is shown in Fig. 1. *A B* is a small coil, oblong in shape, wound of No. 44 B. W. G. copper wire, and supported half on each side of a sheet of mica. It is suspended from each end by strips, 10 centimetres long, of rolled German silver wire, each strip having a loop, which is passed over a small brass hook riveted on to the mica, and in electrical communication with a terminal of the coil. The strip *C A* is in electrical connection with the case of the instrument at *C*, while the strip *D B* is insulated from it at *D* by an ebonite plug attached to the torsion head *E*. Inside this latter is a commutator for automatically reversing the current, so as to take readings on each side of the zero. It consists of four semi-circular strips of copper, cross connected as shown in Fig. 2, *a* and *b* being connected to the two battery



FIGS. 2 AND 3.—MAGNETIC FIELD MEASUREMENTS.

terminals. Two springs, one soldered to the case, the other insulated from it, but connected to the end of the suspending strip *D B*, press on these semi-circular strips. When the torsion head is at zero no current passes, the springs then being at *c* and *d* respectively (Fig. 2). To take a reading the torsion head is turned, thus sending the current through the coil. Should the latter be deflected in the wrong direction, the current can be reversed by means of the plug contact, *P*, attached to the battery leads. Readings are taken on each side of zero in order to eliminate any error due to imperfect balancing of the coil, an aluminium pointer *G*, attached to the coil, being always brought by the torsion to the zero position on a small scale.

In order to obtain at once a spring suspension and an adjustment for the torsion of the strip, a particular form of geometrical slide is used. *A A'* (Fig. 3) is a thick brass tube, turned at *B B'* to a slightly conical plug to fit the tube of the instrument (Fig. 1). Two grooves (seen in plan at *C C*) are made along this tube, a cross-head *F* (Fig. 1) on the screw *E F* fitting into them. This screw is drilled along its whole length to admit a thick wire *H I C*, the latter having a cross head *I*, also fitting into the longitudinal grooves. These two cross heads are then connected to the two ends of a spiral spring, in such a manner that they are pressed by it against opposite sides of the grooves. The suspended strip being connected to the central wire *H I C* at *C*, its tension can be increased or diminished by means of the nut *K*, without altering the position of the coil. Any sudden jerk will also be taken by the spring, thus obviating the risk of stretching the suspending strip. Scratches on the wire *H I C* near *H* indicate the tension used.

As a source of current a Hellesen dry cell is used. When joined up through 50 ohms the E. M. F. of the cell is practically constant, while its internal resistance is negligible.*

The resistance of the instrument having been made up to 50 ohms, it follows that its sensitiveness can be varied by introducing an independent resistance in the circuit.

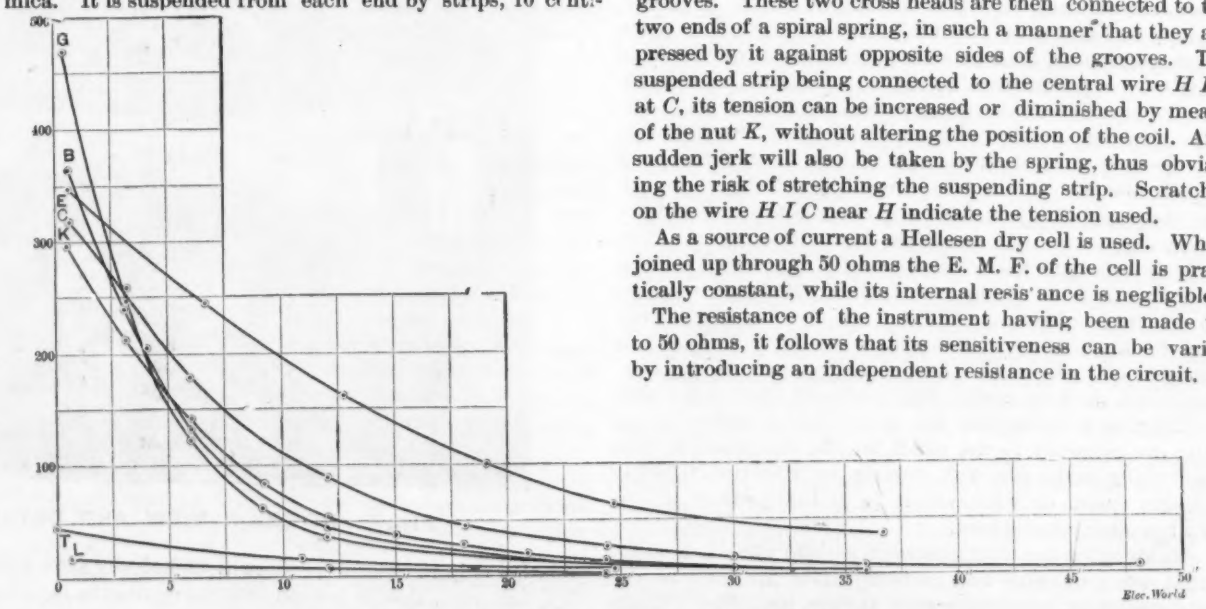


FIG. 4.—MAGNETIC FIELD MEASUREMENTS.

Let C = constant of instrument (*i. e.*, field for 1° of torsion, with no external resistance in circuit);

n = multiple of 50 ohms in circuit, exclusive of resistance of instrument;

θ = mean angular torsion;

then

Field in C. G. S. measure = $C\,(n + 1)\,\theta$.

C was determined, and the instrument calibrated,

*Abstract from the *Philosophical Magazine*.

† After the completion of this instrument our attention was called to some experiments of Messrs. Siemens and Halske, in which the same principle was used.

"In order to measure the intensities of the rotary field, a coil was hung in the centre of the ring, in such a way that its magnetic axis was perpendicular to the measured direction of the resulting magnetic axis of the ring. The coil was then excited by a continuous current, and was kept in position by a spring. The torque of the spring served as a measure of the intensity."—"Deductions and Experiments on Rotary Currents." A. du Bois Reymond, *Electrical Review* (London), June 5, 1891, Vol. XVIII., No. 706.

* See *Electrotechnische Zeitschrift*, August 1, 1890, Vol. II., No. 31. Republished in pamphlet form by Siemens Bros. & Co., Ltd. We have independently verified these results.

between the coils of a galvanometer of the Gaugain type through which a known current was passed. For an E. M. F. of 1.45 in the dry cell it was found to be .293. The error shown in the calibration was always below two per cent.

Fig. 4 shows the fields measured at various distances from different dynamos, the distances plotted as abscissæ and the fields as ordinates. It is noticeable that machines of the multipolar type show a much steeper curve than other dynamos. This is especially noticeable in the case of the Gulcher dynamo curve (*G*).

In Fig. 4 *G* is the curve of the Gulcher arc dynamo; *B*, of the Victoria Brush; *E*, of the Elwell-Parker transformer; *C*, of the Crompton dynamo; *K*, of the Kapp dynamo; *T*, of the Thomson-Houston arc dynamo, and *L*, of the Laring, Wharton & Down ship dynamo. The curves in all cases represent the falling off of the fields at points in directions at right angles to the axes of the armatures.

The Problems of Commercial Electrolysis.—III.*

BY J. SWINBURNE.

ELECTRO-METALLURGY OF COPPER.

Electrolysis may be employed either in connection with the extraction of the copper from its ores, or in refining copper, especially where there is silver alone, or with gold in addition, to be extracted.

In the first case—that of extraction of copper from pyrites—the ore may be converted into matte, and the matte can be cast into anodes, or the ore may be acted on by oxidizing solutions produced by electrolysis, or the two processes may be combined.

In the first method the matte is cast into anodes, which are treated in baths of copper sulphate with copper cathodes. The sulphides are attacked, sulphate of copper is formed, sulphur and impurities being left on the anode. The copper is deposited, and iron remains in solution. The chief difficulties in connection with this process are that the anodes are brittle and troublesome, and are often eaten away unevenly, and the solution becomes richer and richer in iron salts. In addition to this, it is stated that the circulation of the iron salts must be avoided, otherwise ferric sulphate will be produced at the anode and reduced at the cathode; and this process will go on wasting power over resistance. Some sort of diaphragm is therefore necessary.

It must be pointed out that sulphuric acid can be made from the sulphur dioxide given off in the first roasting of the ores, or from the surplus ferrous sulphate. The ore can be roasted so as to have a good deal of soluble oxide of copper, which can be dissolved in the acid and treated electrically. Merely working with anodes is an incomplete process; it is better to combine it with extraction by lixiviation. The solution, after being in contact with the anode, so as to contain ferric sulphate, is led to the ore. The ferric sulphate is reduced, and the copper and iron are said to be dissolved, and if there is oxide of copper it is taken up by sulphuric acid. This solution is led to the cathodes, where the copper is thrown down, and is then passed to the anodes, where the iron salt is oxidized. The various impurities and the precious metals are left with the sulphur of the anode. The sulphur is burned into sulphur dioxide, which goes to the chamber, and the silver, with the gold, if there is any, is extracted. The sulphate of iron can be burned into sulphur dioxide, and the iron oxide sold as Venetian red. This is, in rough outline, the Marchese process. It may seem strange to those unacquainted with industrial chemistry that if you want to extract copper you should also become involved in making sulphuric acid and red paint; but in chemical works by-products must be utilized, so that often making one thing involves the production of a number of other substances, which have at first sight nothing to do with it. Messrs. Siemens & Halske avoid the necessity of making anodes of matte, by employing carbon. The ferrous sulphate is thus oxidized into the ferric salt, and this is used to lixiviate the crushed and roasted ore. The solution is then led to the cathodes first to take out the copper, then to the anode to oxidize it, and so on.

In the Hopfner process, chloride of copper is used instead of sulphate. The action is stated to be as follows: Cupric chloride is formed at the anodes; this is led to the matte, where it attacks the copper sulphide, forming cuprous chloride and sulphur; and it is also said to dissolve the silver as well as the copper, which, if possible, would be a drawback. I do not know why the chloride should be preferred to the sulphate; and no information is given as to what is done with the sulphur in the ore, and with the excess of ferrous chloride that must be produced.

The Marchese and Siemens & Halske processes are in commercial operation, and the electric extraction of copper is already a growing industry. The electromotive force necessary for this process is less than a volt; so that, assuming coal to be used as in the estimate at the beginning of this paper, the electrical cost is 14s. 5d. per ton for the extraction of copper. I cannot give the whole cost, as that involves so many considerations. This figure will give copper smelters some idea of the saving of replacing the ordinary refining process by electrolysis.

*A paper read before the Institution of Electrical Engineers, London. For the first and second sections see THE ELECTRICAL WORLD of Sept. 3 and 10, 1892.

In dealing with such a valuable substance as copper the time element must not be neglected. The interest on the money locked up in the copper under treatment may be a very serious item. This is an objection of some weight in the case of matte anodes, which take some time to dissolve. The whole of the copper turned out is not obtained from the anodes; but, taken all round, it may not be far wrong to assume that the copper takes about three months to pass through the works where matte anodes are employed. If the output is, say, 1,000 tons a month, the copper represents a capital of some £150,000, and the interest increases the cost of refining some 12s. a ton.

Electrolysis may also be employed for refining crude copper. In this case the process is simplicity itself. The crude copper is made into anodes, and thin plates of fine copper are used as cathodes, the electrolyte being sulphate of copper. Pure copper is deposited on the cathodes, and the impurities, and the silver and gold, are left in the mud, and the precious metals are extracted in the ordinary way. It is usual to employ cast anodes, and arrange the plates in each vat in parallel, the vats themselves being coupled in series. This arrangement is clumsy, and should be modified. I have had an opportunity of examining the large copper refinery at the Bridgeport Copper Works, and it may be well to describe the arrangement employed there. As the books were examined by Mr. J. H. Hays at the same time, I am also able to give you the actual cost of the process, without having too roseate a hue imparted by an enthusiastic inventor. The refinery is arranged and worked in accordance with the patents of Mr. E. S. Hayden. The departures from ordinary practice are made with the view of reducing the amount of copper under treatment and of keeping down the cost of labor.

The anodes, instead of being thick cast copper, are sheets of thin rolled metal. The cost of rolling is small, and the plates used can thus be made thin, and dissolved very uniformly. Each vat contains a number of plates arranged vertically and across the vat. At one end a thin plate is supplied as a cathode. The first plate is made the anode, and copper is eaten off one side of each plate, and deposited on the plate next to it. The result is that each vat acts as a number of small vats arranged in series, and requires only two electrical connections. The whole question of large leads and connections is thus solved. There is almost no waste through partly consumed anodes, as the whole plate is eaten away evenly. The process is carried on until the whole of the anodes are eaten, and their place taken by the pure deposited copper. The plates are hosed and removed, and the slime is treated to recover the silver and gold. The product is the highest grade of copper in the market, and fetches £6 10s. a ton above "tough cake," or £4 10s. above "best selected." Silver and gold are completely separated without loss, and as 35 oz. of silver and ½ oz. gold per ton are allowed as tare, any copper containing more than that yields £8 per ton in bullion. Argentiferous copper thus yields at least £14 10s., leaving the gross profit of £12 10s. at present rates. I have here taken the cost of refining at £2 per ton. The actual cost of refining copper depends on the output of the works and the cost of labor. In Bridgeport it came out just over £2 a ton. With modern dynamos, and reasonably good engines and labor at English prices, the cost would be a good deal less, say 20s. to 25s. per ton. The use of thin plates as anodes also reduces the capital investment in copper, which, as already pointed out, may be enormous, and thus lessens the margin to be allowed for fixed charges.

The Elmore process is too well known to require a full description. The copper is deposited on a revolving mandrel and burnished by a traveling agate burnisher. By this means copper tubes of great strength are made, and by cutting the tubes sheets are produced. Narrow strips can also be made, and these can be drawn down into high-grade copper wire. A number of thin sheets can be made by depositing several separate coatings one over the other on the mandrel. The sheets separate when the tube is slit lengthways.

Writers of books on political economy are fond of saying that the chaffering of the market makes people manufacture in the cheapest way, and that the cheapest and best goods displace dearer and inferior qualities. They forget the interference of custom, ignorance, and prejudice. If a new process is brought out, it takes ages before it is taken up abroad, and still longer before Englishmen will touch it. Here we have a process of refining copper at a gross cost of £1 or £2 a ton, with a gross profit of £13 or so; and yet copper refiners continue their barbarous methods. The first manufacturers to take up copper refining by electrolysis on really modern principles have a chance of making fortunes before the market is disturbed.

ANTIMONY.

Little has been done in the way of treating antimony ores electrolytically. Dr. W. Borchers proposes to use the solution of sulphide in sodium sulphide as an electrolyte, and to deal with the ores. The specimens of antimony ore that I have examined have been perfect insulators, so that regulus of antimony cannot be used as an anode. There will be an accumulation of sulphur in the bath, and it will probably insulate the anode. It is also difficult to say what material could be employed as anode in such a solution. Carbon would be attacked, and platinum would be too expensive, and other metals would be converted into sulphides. As the reduction of antimony, by iron, for example, is comparatively easy, there does not seem to be much opening for the electrolytic treatment in dealing with its ores.

RECOVERY OF TIN FROM SCRAP TIN.

This, of course, can be readily effected by electrolysis. The scraps can be made the anode in an alkaline solution, in which iron is not attacked. Though such a method removes all the tin from the surface, it may leave some alloyed with the iron, as no doubt some tin sinks into the iron during dipping.

Electrolysis has also been employed to assist in cleaning plates before dipping. I do not see how it can be of much service here, however. I have examined one of the processes, and it was said to be working very successfully, but I found the brushes had been accidentally left off the commutator.

ELECTRICAL TANNING.

Electrical tanning, though it depends on electrolysis, differs materially from all the processes already described in not depending on the isolation of radicals at the electrodes. Ordinary tanning is a very slow process, because it takes a long time for the tannin to diffuse into leather properly. If this substance is an electrolyte, it has a very complex molecule, and therefore diffuses very slowly. The outside of a thick piece of leather also becomes tanned, and to some extent protects the rest from the diffusion of more tannin. We may get an idea of what I suggest is the action in electrical tanning by regarding a hide as being made up of cells in groups, with interstices among the groups. If the skin is merely left in tan liquor, it takes months for the liquor to penetrate even into the interstices. It has then to diffuse through the walls of the cells. This is necessarily a very slow process, when it is remembered that the gelatine uses up the tannin as it comes in. Mechanical agitation has been tried, but it does not accelerate the process much. It is probable that agitation helps the liquor into the interstices, but, of course, it cannot help it into the insides of the cells, or, in fact, into those parts of the leather which are accessible by diffusion alone. The agitation can thus only perform the first part of the process—that is, getting the liquor into the pores that are open to it.

Passing electricity through the vats without agitation has also been tried, but it, again, is of little or no use by itself.

If, however, the skins are agitated and electricity is passed through the bath at the same time, the agitation circulates the liquid into the interstices, and the electric current sends the tannin through the walls of the cells, so that the leather is made infinitely faster than by the ordinary methods. Dr. Rideal and Mr. Trotter have made numerous and elaborate experiments on electrical tanning. The results of their work are given in the exhaustive paper read before the Society of Chemical Industry. I brought forward this as being probably the explanation during the discussion on their paper, and it agrees entirely with the results they obtained. The best results, according to this theory, would be secured by agitating the hides first to get the liquor into all the interstices uniformly, and then electrolyzing to get the tannin into the skin itself; then agitating to refresh the solution in the pores, and then electrolyzing to refresh the Messrs. Rideal and Trotter showed that this method does, in practice, give the best results. Leather made in this way also has a better chance of being uniform, because the outside is not acted on perceptibly quicker than the inside.

Tanning by agitation and electrolysis combined seems to have been invented by Messrs. Worms & Bale, and their process has been worked successfully for some time past in France, and in England by the British Tanning Co. Mr. Groth has developed a modification, and is also making leather by this process. Groth's appears rather better than ordinary leather, being more uniform in texture, and giving better results when tested for tensile strength. It is shown at the Crystal Palace Exhibition this year.

OZONE.

Now that induction coils in the shape of transformers have become commercial, there is every reason to expect that ozone will be made industrially. Mr. Fahrig has already been making ozone commercially in this country. He employs an alternate current which works a transformer which gives a high electromotive force. Air is first drawn through an apparatus which is supposed to separate the nitrogen by diffusion. As nitrogen and oxygen have nearly the same densities, it is hardly likely that much nitrogen is separated. The air is then led through the ozonizers. These consist of piles of corrugated metal plates with sheets of celluloid between them. They are alternately positive and negative, being connected to the high-pressure side of the transformer. There is thus an alternating discharge from the corrugated electrodes to the celluloid sheets, so that the air is ozonized on passing through.

Messrs. Siemens & Halske employ ozonizers of the more usual form. Two concentric glass tubes are used. One electrode is inside the inner, and the other is outside the outer tube. High-pressure transformers are, of course, employed, and the air, or oxygen, is partly converted into ozone on its way there. Very little is known about the electrolysis of gases, if such an expression is ad-

missible. The so-called silent discharge seems to work best, but the whole subject now demands quantitive investigation. The use of glass must involve low efficiency, as glass possesses the property of dielectric hysteresis in a high degree. We also want to know the current density and frequency which give the best results. The arc, and, in fact, many forms of electric discharge, produce traces of nitrogen compounds. It is worth pointing out that if under any commercial conditions nitrogen compounds could be produced from air, there would be an unlimited demand. A works situated on a waterfall would have its power and material provided, and the only cost of production would be the interest on plant, and the wages of a man or two to look after the dynamos.

It has been said that chlorine acted on by the electric discharge is affected in the same way as oxygen. In the first place, chlorine is already quite a strong enough oxidant; and in the second, it is difficult to see how chlorine can form an allotropic modification.

Electricity at the World's Fair.

(From Our Own Correspondent.)

Arc Lighting on the Midway Plaisance.—Along the centre of this Plaisance a wide granitoid boulevard extends, on each side of which will be a long narrow ribbon of green, broken at intervals by entrances to the various displays here given space, and which include Turkish, Moorish, Dutch, Dahomey, Chinese and Austrian villages, panoramas, bazaars and other features in which sales of native productions will be allowed. At intervals of 75 feet along each lawn arc lamps will be supported on appropriately designed posts, and lamps will also be placed at intervals along the inclosing fence. These posts are of artistic design and consist, in detail, of a sloping cast iron base, 10 inches high, supporting a cast iron shell seven inches high, in which rests a wooden mast that upholds a cast iron cap forming the base of the golden lyre within which is suspended the arc lamp that is protected by a royal canopy of galvanized iron, 20 inches in diameter and suitably crimped and painted. At some of the entrances groups of three arc lights will be supported on posts of similar design, but having a triangular top in which lamps will swing, and over which a protecting canopy in the form of three miniature domes of harmonious design will be supported. Each lamppost will be numbered, and that number entered in a register that shows the location, grade, by whom erected, by whom lamp was suspended and connected in circuit, and every other detail that will insure a perfect record. From early evening till the closing hour all the arc lights in the Midway Plaisance, over 200 in number, will be maintained in circuit, but during the remainder of the night only the lamps along the fence, and every alternate light on each side will afford illumination. The circuits that will carry the current necessary for this illumination will be drawn into three lines of ducts holding two wires each, that have been placed beneath the centre of the lawn on each side of the roadway. The lampposts will be supported on wooden foundations abutting the manhole from which the leading-in wires pass up through a curved vitrified pipe into the post, there to be connected to the lamp. The manholes have a twelve-inch drawing-in capacity, allowing the use of an eleven-inch drawing-in rod, and the covers are of iron with the usual lifting ring. Here, as in every part of the grounds, Frederick Sargent has taken extra precautions to see that ample duct capacity is placed in position to avoid ever again disturbing the earth; has also had cross ducts placed at intervals of 500 feet, and has alternated the lamps on the circuits so that darkness would only prevail in the event of an accident to every one of the five dynamos that will be employed. No arrangements have yet been made for supplying arc lights to the exhibitors in the Plaisance, but the Exposition officials will have an abundance of the Westinghouse incandescent light to dispose of, both for ordinary illumination and for decorative purposes, as the Westinghouse company has laid a line of six ducts two feet inside of the grass plots and parallel to the arc circuit ducts. Each building will be supplied with a separate converter placed within a pit, and the wires carried beneath the walk and into the building, which will be wired by the Exposition officials, the exhibitor paying for the special fixtures, for any extra wiring, for the current consumed, and for the renewals, should these be necessary, the officials installing the first supply of lamps. The brilliancy of the decorative effects in this foreign quarter both without and within the quaint structures, where the incandescent lamp will be utilized entirely in connection with the attractive Japanese and Chinese lanterns, can be clearly anticipated by remembering how daring in the use of high colors are the Egyptians, the Moors, the Turks, the Chinese, and other natives of that portion of the globe where the intense brilliancy of the sun affords suitable contrast to colors that might appear too bold under our sober northern skies.

Incandescent Lighting.—Under the original plans of the Exposition it was thought that 100,000 incandescent lamps would be amply sufficient for interior illumination with the large number of arcs that will be utilized. But the allotment has been twice increased, and it would now appear that no less than 250,000 to 300,000 incandescent bulbs will be in circuit, and in anticipation of such an increase ample provision has been made in the respective circuits. The general allotment is about as follows: Manufactures Building, 28,000; Art Gallery, 12,600; Annexes, 8,000; Administration Building, 15,000; Machinery Hall, 7,600; Basins, 6,100; Peristyle, etc., 5,000; Agricultural Building, 5,000; Government Building, 5,000; Mining Building, 4,800; Transportation Building, 3,200; Woman's Building, 3,200; Choral Building, 2,000; Offices and Construction Department, 1,800; Fisheries Building, 1,000. Among the State and Territorial buildings, about 15,000 lamps have been allotted, the average number to each being 200, and the exceptions being Illinois with 2,500; New York, 1,000; Pennsylvania, 800; California, 600; Iowa, 300; Maryland, 250. Some of the State buildings are so arranged that the full allotment will not be required, while in others it will have to be increased, especially where decorative designs in bulbs are requested. The same number of lamps, 200, has been allotted to many of the smaller foreign buildings, but France, Germany, Great Britain and Japan will have at least 500 each. This allotment does not include the Midway Plaisance, where 15,000 at least may be used, nor does it include the Electricity Building, where 100,000 lamps will be used if the plans of the exhibitors are realized. In many places this light will be intensified or concentrated by the use of Frick reflectors, over 4,500 feet being used in the art galleries alone.

The Buildings.—Time is the only factor of value now worthy of consideration by the contractors, and every point is being strained to have the grounds and buildings completed in October. Over ten thousand men and countless teams are now employed within the grounds, the majority working on eight-hour shifts on the buildings, all night on the small, and sixteen hours on the large structures, arc lights being utilized in every conceivable way to hasten the work along. On the Manufactures Building 1,200 men are employed; 1,300 "staff" workers are preparing the white enveloping material; 650 skilled laborers are rapidly completing Machinery Hall; 700 artisans are assisting the landscape gardener to convert the grounds into a vast park; 750 men are paving and duct laying and sodding the Midway Plaisance. New York has 120 men on her building, and Illinois 240. Over 16,000 carloads of building material have already been used up.

The design and plans for the principal entrances have been approved, and the working drawings given out. The main gates will be at 57th, 59th, 60th, 62d, and 64th streets, with one entrance on the north, and one at the south end of the grounds. Then there will be an entrance to the Midway Plaisance at Cottage Grove Avenue, and one on each side at about the centre of the Plaisance. There will also be entrances for employes and teams at other points.

Work on the power plant in Machinery Hall is progressing rapidly, and two Lane & Bodley engines, one of 300 h. p. and one of 150 h. p., have been added to the plant, and will be used in driving Thomson-Houston arc light dynamos. Stirling boilers will be added to the steam plant, and the Falls Rivet and Machine Company will place considerable shafting in service.

Over 30,000 h. p. in steam must be delivered for use in operating engines and other machinery, and maintaining perfect service for fourteen hours a day, and the fuel oil that will be used in supplying the heat that will evaporate the water within the boilers will be stored in a reservoir consisting of twelve cylindrical steel tanks, eight feet in diameter, by twenty-five feet long, that are firmly set in masonry and enclosed within a cemented brick structure 75 feet square. This building is located in the southwest corner of the grounds, is sunk to a depth of six feet, and rises but seven feet above the street grade, while over all a deep layer of rich loam will be placed, and the surface embanked and sodded. Each tank has a capacity of 225 barrels of 42 gallons each, making a total capacity of 113,400 gallons, and each tank is separately connected and interchangeable. The oil will flow into this reservoir through a six-inch main connected directly to the big oil tanks at Whitings, Ind., just across the Illinois line, where the relay station of the big pipe line running west from Lima, O., to Chicago, was established last year. Above the reservoir a stand pipe will rise thirty feet, into which Snow duplex pumps, having a capacity of 365 gallons of oil a minute, will force a constant stream of oil that will flow from here through a five-inch pipe to the banks of boilers that are now being located 3,200 feet away to the northwest of the reservoir. Under the boilers about 500 burners will be employed, and 60,000 pounds of oil consumed each hour, or 12,600 gallons each day, operating from 9 A. M. to 11 P. M. By means of an electric gauge a mean effective pressure of eight pounds will be maintained at the burners, and provision is made for the excess of oil, over and above what is required, being returned to the reservoir through an outlet pipe in the event of the pumps being speeded beyond the capacity of the burners. This fuel oil plant is being rapidly constructed by Mr. C. O. Billow, of the National Supply Company, Chicago, will cost when completed about $35,000, and includes the reservoir and the power-house, piping, burners, etc. Within the power-house two 40 h. p. vertical boilers will be placed to supply the necessary steam to the pumps, and also to 3,200 lineal feet of radiating surface that is placed parallel to the five-inch pipe to prevent any thickening of the oil during the coldest weather we may have this coming winter, while a 50-light Jenney incandescent dynamo, driven by a 4 h. p. vertical engine, will supply the necessary light within and about the reservoir, where no open flame will be allowed. Owing to the perfect manner in which this plant is being erected, it is expected that there will be no perceptible odor given off, either at the boilers or at the reservoir, where the only outward opening is in the stand pipe, that has two holes one-eighth of an inch in diameter to admit the necessary air requisite to prevent the formation of a vacuum within the tanks; thus it will be a point of much interest to all heavy users of steam who may hereafter visit the grounds. As previously mentioned in these columns, the oil is to be furnished at the rate of 70 cents a barrel till 1893, and then at the market rate, not exceeding 72½ cents a barrel.

The Chicago Telephone Company is now at work on what it claims will be the finest telephone exchange in the world. The latest improved instruments and switchboards will be used and connected in on complete metallic circuits, and, as the long distance line to New York will then be completed, visitors will probably have an opportunity of endeavoring to talk directly with friends in New York and other Eastern cities. Probably more than 600 instruments will be in use in the various buildings, while there will be at least 25 toll stations distributed at convenient points about the grounds.

The Multiple Speed and Traction Company has been granted permission to install its moving sidewalk upon the long pier at the park. The company is to pay the Exposition $25,000 as its portion of the cost of the pier, payment to be made as construction advances. The company will also pay 33⅓ per cent. of its gross receipts from all sources, and agree that the fare on the walk shall be 5 cents per person, unless the price is changed by mutual consent. As it was found to be less expensive to build a pier out into the lake, rather than to secure deep water near the Peristyle, all the lake craft will land at this long pier, and passengers can then walk into the grounds or ride on this moving platform, as may seem most convenient and agreeable, the moving platform not occupying half the width of the wide pier.

Meeker & Williard, of Chicago, have been granted a concession to operate twenty steam launches on the exterior waters of the Fair Grounds; each will be fifty feet long, equipped with triple expansion compound engines, with keel condensers, and anthracite coal will be used, so that neither smoke nor steam will be emitted. The route for these boats will be from the south pond north to the south inlet, through it, and around the main pier, 2,500 feet long, west again to the main basin, where a turn will be made, and then north along the lake shore to the north inlet as far west as the Fisheries Building, and then return south over the same course. The round trip over this line will be 25 cents; single trips from one end of the course to the other will be 15 cents. Every railroad centering in this city can now make connection with the Illinois Central and Baltimore and Ohio tracks, either direct or by using the Belt Railway or Chicago and Northern Pacific (Calumet terminal). The charge to be made by the two roads for allowing other lines over their tracks into the Exposition grounds has been fixed at one cent a mile a passenger, and as the distance in each case is less than five miles, the rate will not exceed five cents.

The World's Fair Tower Company has been granted a concession to erect a spiral tower about 560 feet in height upon the western end of the Midway Plaisance. The contract provides that the company shall pay to the Fair one-third of the gross receipts of ascensions and descents and such other features as may be peculiar to the tower, shall bear the entire expense of installation and operation, and deposit with the Exposition $10,000, and also furnish a $50,000 bond for the faithful performance of the contract. The intention is to have electric railway trains carry passengers up the long winding road that will be firmly supported by the steel columns. From the platform at the top, 200 feet in diameter, it is expected that visitors will secure a fine outlook over the grounds.

Appointments.—Director General Davis has made among others the following appointments: A. A. Abbott to be superintendent of the vehicle division in the Department of Transportation; D. C. Boise, of West Virginia, to be superintendent of the coal industries in the Department of Mines and Mining; Capt. Arthur Clark, of Boston, to be superintendent of the entire marine service of the Exposition, with the title of commodore.

In General.—The Transcontinental Railway Association has notified the Exposition authorities that commodities of a perishable nature or not likely to be returned to the point originally shipped from, will be carried at one-half the regular tariff rate. All other exhibits will be subject to the original arrangements of full rates on the forward journey and free return ownership unchanged. The Western Passenger Association has adopted a rate of one fare and a third from points within a radius of 350 miles of Chicago, and a rate of one fare for the round trip to the dedicatory exercises in October outside of that radius. The water pageant that was expected to prove so attractive a feature in the evening

following the dedicatory exercises, has been abandoned on the ground of interfering with the safety of the great crowds that are expected to be present. Regarding this matter President Higginbotham says: "There will be an immense crowd on the grounds during the dedicatory ceremonies, and it is expected that there may be fully 350,000 people present on dedication day. The feature of safety in this great crowd, massed as it will be immediately around the Manufactures Building, was considered by the council, and it will be necessary to possess every channel of communication. More permanent bridges are imperatively needed over the lagoons, and they must be constructed at once. They would, of course, interfere with the water pageant, but the safety of the people is a paramount consideration and far more important than any pecuniary interest which might be involved in the display of the floats on the waters of the park. It was, therefore, considered impracticable, and practicability and public safety constituted the only reasons why the original scheme has been relinquished."

Following the publication in The Electrical World of September 3d of the adoption of the electric motor for operating the majority of the moving exhibits, many of the department chiefs were called upon by parties desirous of securing the names of exhibitors with whom they could correspond relative to the purchase of motors. But in each case, so far as known, no list was given out, as the Director-General has so ordered. One chief, however, kindly gave his visitor a pointer to "secure the leading journals in each line of industry, and the advertisers appearing therein will be the exhibitors in the respective sections of the World's Fair. A house that is not sufficiently progressive to advertise cannot be depended on to make a creditable exhibit, and only attractive and interesting displays will be given space."

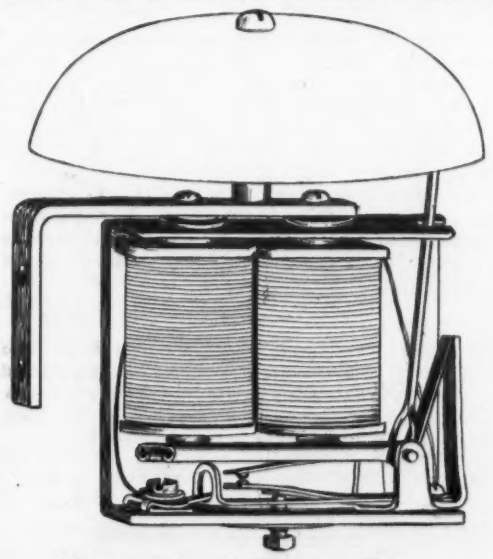
The Siemens & Halske Company of America has prepared plans for the series of special electrical effects that will be used in presenting a historical pantomime illustrating the dramatic features of the life of Columbus, particularly dealing with scenes incident to the discovery of America, based upon the description given in Washington Irving's life of the discoverer. Fancy dances are to be a feature of the performance, and the ballet costumes will be historically correct, being taken from famous paintings. In all fourteen ballets will be given, about 250 people being required to produce the spectacle. Mrs. M. L Littleton, of Nashville, Tenn., the author of the pantomime, and Mrs. W. Newton Lynch, of Martinsburg, West Virginia, have raised the $300,000 necessary to build and equip a theatre that will seat about 3,000, and are now asking the council of administration for permission and space to erect it in the Midway Plaisance.

H. E de Ville, a Parisian, is at the Great Northern Hotel in the interest of a syndicate which proposes to flash accurate photographs of scenes at the World's Fair over the wires and have them reproduced on a large scale on a canvas background in the various cities, by means of a system of telephotography. M. de Ville will not go into details regarding the system that will be used, but refers inquirers to an article that appeared in the Paris *Figaro* some three years ago, commenting on the experiments of M. Henri Courtonne, a French chemist. F. DE L.

CHICAGO, Sept. 10, 1892.

Edwards & Co.'s Electric Bell.

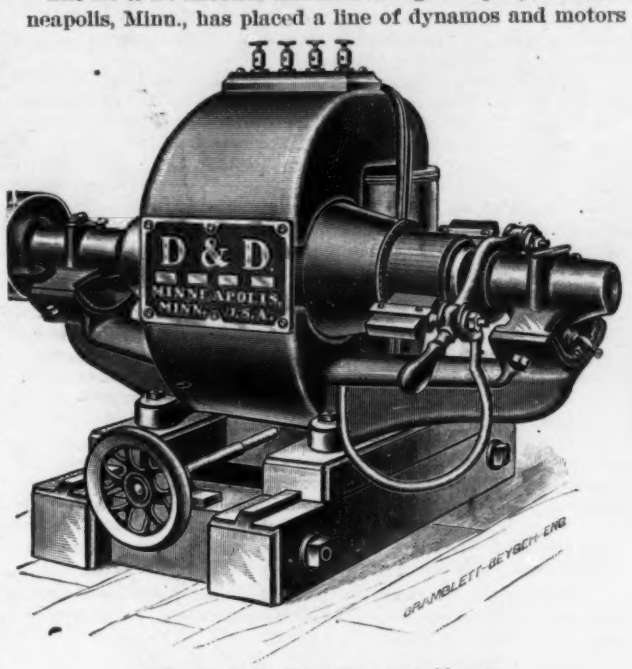
A novelty in the line of electric bells and buzzers has been brought out by Edwards & Co., corner of Fourth avenue and 144th street, New York City. These bells are so arranged that the circuit through them is never broken except at the push button, and the magnets are cut out so that they discharge all their magnetism without interfering with the vibration of the armature. This form of bell is especially adapted to circuits where a number of bells are to be rung in series, as each one cutting out its magnet gives to the rest the benefit of the full current. This arrangement is much more practical than where only one vibrator is in circuit, the rest being stroke bells. This bell is particularly suited for annunciator work, as by its use the circuit is not broken and the annunciator drop receives the full strength of the current. If an extra large bell is required, the difference in resistance between it and the drop would not interfere in the least with its proper working. In many cases it is preferable to use a buzzer with an annunciator, but this has not been practicable in the past, since its rapid vibration kept the drop from indicating. This form of buzzer, however, overcomes this objection.



EDWARDS & CO'S. ELECTRIC BELL.

The D. & D. Dynamo and Motor.

The D. & D. Electric Manufacturing Company, of Minneapolis, Minn., has placed a line of dynamos and motors on the market of the design shown in the accompanying illustration.

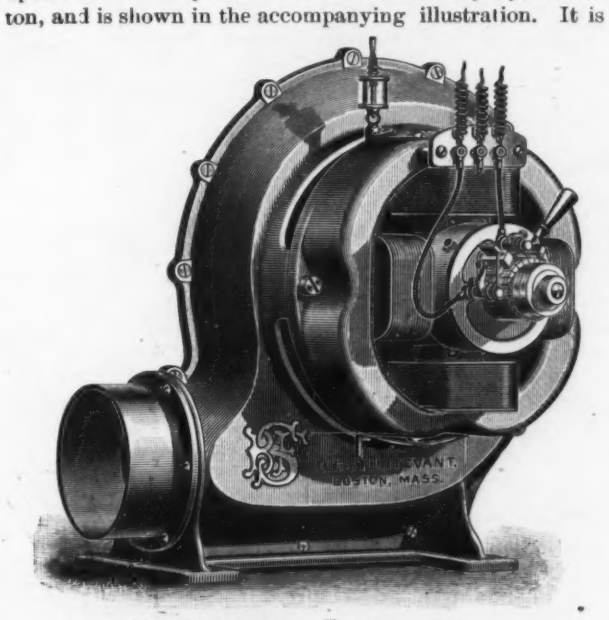


THE D. & D. DYNAMO AND MOTOR.

The single field magnet is of wrought iron and the amature a Siemens drum. The brush holders are made for multiple carbon self-adjusting brushes, so constructed as to insure perfect contact between each individual carbon and the commutator. The bearings are made interchangeable, being of bronze, in the form of a sleeve, turned to gauge, and in case of wear or injury can be easily and quickly changed. The arms which support the bearings, it will be seen, are cast in one piece with the base and the pillow seat bored, thus insuring strength and alignment of the bearings.

The Sturtevant Electric Fan.

The rapid introduction of electricity as a motive power is continually making the convenience of the electric fan better appreciated. A new form of fan has been placed upon the market by the B. F. Sturtevant Company, of Boston, and is shown in the accompanying illustration. It is specially adapted for all locations and for any kind of work. Neither engine nor belt is required, and starting and stopping is merely a matter of adjusting the switch. It can be readily seen that the fan can be set in any position without affecting the running of the motor. For this reason the fan may be located to discharge in exactly the required direction, and connection easily made by pipe, which can be straight and direct to the point desired.



THE STURTEVANT ELECTRIC FAN.

The electric motor is of approved design, specially arranged for fan propulsion and capable of extensive and continuous use without attention. It has been designed and is manufactured complete in every detail by the Sturtevant company, and all parts are made on the interchangeable plans so that repairs can be furnished quickly. The motors are wound for any voltage, and special designs will be brought out from time to time.

Obviously any type of fan can be fitted up in this way and fans can be used for almost any purpose. For ventilation they are readily adaptable, particularly in the case where the introduction of an engine and boiler would be entirely out of the question. A mere connection of the wire to the power circuit does away with this and places the fan under immediate control. The high speed at which it is possible to run these fans gives them a large capacity, so that a small fan occupying but little space and easily located overhead can be used to ventilate apartments of considerable size, and when run at a proper speed they are noiseless and there is no inconvenience whatever.

An interesting application of the Sturtevant electric fan is that of one which has recently been shipped to one of the largest silver mines in the world in Bolivia, South America. This fan has a Sturtevant electric motor directly attached, the motor being covered by a heavy steel-plate case to keep out the dirt and prevent injury to the motor from surrounding objects. This fan is provided with an eye-bolt at the top of the case, and is to be suspended by a rope or cable in the mine shaft, and the fan or motor will be raised or lowered to suit the circumstances, and the blower being driven by an electric current is specially adapted for this purpose.

OESTERLEIN'S FRICTION CLUTCH PULLEY.

Oesterlein's Friction Clutch Pulley.

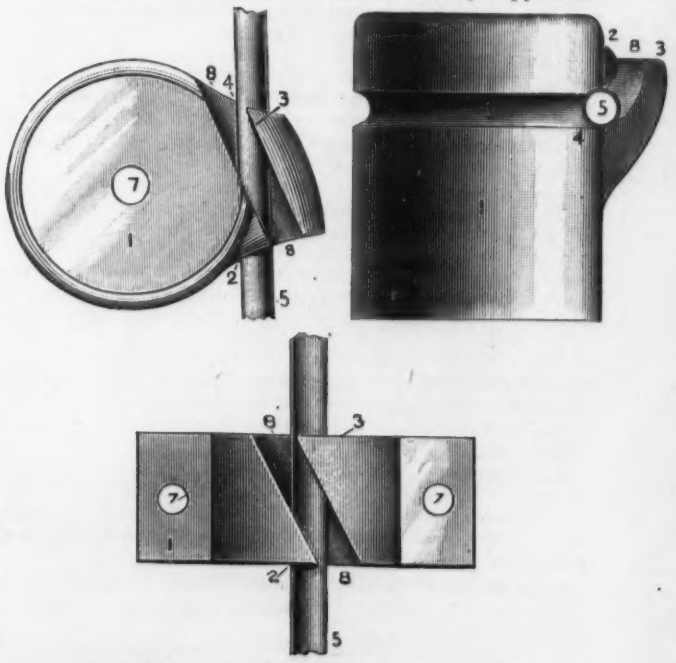
Every branch of mechanics that has been brought into any connection with practical electricity has been benefited by the impulse given through the new and exacting demands made upon it. The demand for a good friction clutch has resulted in producing a number of new forms, one of which we illustrate, that is manufactured by W. Oesterlein, 201 West Second street, Cincinnati, O.

The object of Mr. Oesterlein was to design a clutch with the largest possible frictional surface, clutching the pulley with equal pressure all around and controlled by one lever, the tension of which can be easily adjusted with a single screw.

The Conover Insulator.

A form of insulator which possesses advantages over that commonly used is shown in the accompanying illustrations, and is the invention of Mr. C. E. Conover, 366 Vine street, Cincinnati. Its construction can be seen at a glance. A groove or seat for the line wire is provided, over which groove ears project, so that by turning the wire a little it can be slipped in, but when it straightens into place it cannot get out, as is shown in Fig. 1. There is also a groove around the top of the insulator, Fig. 2, for a tie wire. Fig. 3 shows a modification adapted for use either in a horizontal or perpendicular position.

It will be seen that the wire can be readily slipped into place and much valuable time saved. There is also a material saving in wire, as it does not have to be looped around the insulator. Still another point is that tie wires are not necessary, or at least not required upon every insulator, which means an appreciable saving in wire and in the time it requires to tie them. The line wire does not have to be threaded through a hole and pulled tight afterward, but can be stretched and then put in place. A secure seat is provided for the line wire, independent of any tie wire.



FIGS. 1, 2 AND 3.—THE CONOVER INSULATOR.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK AND BOSTON, Sept. 10, 1892.

New York General Financial Stock Market.—During the past week values have partially regained the ground lost on Thursday of the week previous, when the cholera scare struck the market. Notwithstanding the fact that the infection has continued to multiply at Quarantine, and that vessels with cholera cases on board are arriving daily, public confidence has been in a measure restored. The belief is that inside of another week, should the disease be held at bay, the market will once more experience general bullish tendencies. The $2,600,000 gold exported last week was attributed to the lessening of our European credit, due to a falling off of commercial exports. This is undoubtedly correct to a degree. Notwithstanding, we have exported no gold this week, and so far as can be learned no definite orders have been given for next week's shipment, although it is said that some gold will go to German ports early next week. The money market has showed a slackening in the demand for funds on account of the cholera scare. Lenders are, however, still conservative, especially with regard to commercial paper. Call money shows the effect of a deficient bank surplus. It is firmer in all Western centres, active at St. Louis, Milwaukee, Portland and Duluth. Time loans stand at about the same rates as those prevailing last year. New York exchange is at a discount at Boston and large Western cities; at par generally throughout New England, and at a fair premium in the South.

New York Electric Stock Market.—The upward movement in the general market has been participated in by this class of stocks to a marked degree. Almost without exception every stock which has received a transaction has experienced an advance. Some are very pronounced and all show the buoyant tendency of the electric stocks. The most pronounced advances were in Western Union and General Electric, and were of the nature of a reaction. Quotations reached were not as high as those a week ago, but the closing to-day was strong, and it is believed that the upward movement will continue, provided the conditions are not positively bearish. North American experienced quite a little activity through each of the days of the week, opening at 12¼ and closing at 13¼. The fluctuations were by eighths through this field of one point, and looked as if interested parties were making a slight attempt at manipulation. American Telegraph & Cable sold through the middle and latter part of the week in small lots, starting at 86¼ and closing at 87. Commercial Cable received one sale on Wednesday of 100 shares at 156. Later in the week it was bid at 158 and held at 160. There is no doubt but what this sale set the price and lowered the quotation of 163 asked. American District Telegraph sold Friday at 61, the only quotation for the week. At the close 60 was bid and 62½ asked. There was considerable activity in Westinghouse stock in the Boston market, but only two transactions in New York. A small lot of E. and M. assenting certificates sold Friday at 74. This is an advance of about 10 points over the last previous sale here. The first preferred stock sold to-day at 103, which was also a material advance. Edison Electric Illuminating advanced upon every sale up to to-day, when it closed at 102 after an opening of 100¼. The stock is evidently prized by investors, and an order for 1,000 shares would undoubtedly run the price up considerably beyond that quoted. Bonds to the amount of $5,000 firsts sold at 105⅞.

Boston Electric Stocks.—Among the first to recover from the severe depression of a week ago, the industrials have gained a large amount of what they lost during those days, when the bottom seemed to have dropped out of the market and when the cholera scared all the strength away. General Electric has renewed its strength and made daily advances from 109, the low point which it reached a week ago, until it has reached 114½ again at the end of this week. All predictions on it are for 120 within a very few days. The raid upon it last week was apparently to shake out the weak stock and make the shorts cover, and this was successfully accomplished by the manipulators, so that at present there is very little stock on the market, and the trading is thereby limited to a few sales, the price likewise to only a small increase, although a steady one. Small sales of the preferred stock have been made at 119. The debenture bonds have sold at 103, a loss of 1 per cent. from the highest price. The present price of Westinghouse stock would seem to demonstrate the legitimate strength in it, for it has regained nearly all that it lost a week ago, and its course this week has proven that it reached these figures to stay, and whatever may be the fundamental cause of them, it is certainly not without some backing. Authoritative parties advise its purchase, and recent experience would surely prove the wisdom of it. This stock and General Electric furnish the bulk of trading among the electric stocks, and besides these there have been frequent small sales of Fort Wayne at a good figure, also Detroit Electric at 7. West End railway preferred closed strong at 87½, and the common stock has also been strong at 73¼, though it has not yet regained its recent loss.

General Electric.—This is another stock for which we prophesied an advance in an ascending market. It went down with a thump last Thursday, touching 110; since that date under steady buying it has advanced to 114, at which figure it closed to-day very strong. If the market continues in its upward career next week, we look for still higher values, although investors should be careful to watch for a reaction. There is a very heavy speculative element in the market just at the present time and comparatively few active stocks. General Electric is active, consequently it is picked out as a field for professional traders whose mission in life, as is well known is to make a turn of one or two points, either on the long or short side. The five per cent. bonds to the amount of $43,000 sold over the different days of the week at 104 to 104½.

The regular quarterly dividend on the preferred stock of the Northwest General Electric Company is payable on Sept. 15 to stockholders of record of Sept. 8. The transfer books are closed between Sept. 9 and 15, and the dividends are payable from the St. Paul, Minn., office.

Wall Street Points.—At the Real Estate Exchange auction rooms this week 1,000 shares of Consolidated Electric Storage Company sold at $2,000.

J. R. Keene, one of the leading bulls in the market of to-day, says that the General Electric Company is earning 17 per cent. per annum on its stock, exclusive of the revenue it derives from various corporations doing business in special lines, and using the patents of the Edison company. Its business is continually increasing, and it is only a question of time when the present rate of 2 per cent. quarterly will be increased. Any person who will buy stock and hold it until next year will get a large advance in the price of the stock as well as the dividend.

John H. Davis & Co., in their monthly circular, say: "There are substantial reasons why street railway securities should grow in favor with investors. Given a location in the active business or desirable residence portion of the prosperous and growing towns or cities, and the steady increase in traffic is assured. The business lies ready at the track; no solicitors are needed to induce it with offer of cash rates or rebates; it loads and unloads itself; it is not affected by droughts or floods, by grasshoppers or Farmers' alliances."

At the office of Messrs. Eaton & Lewis, attorneys for the General Electric Company, a representative of THE ELECTRICAL WORLD learned that a decision from the United States Court of Appeals in the case of the Edison company vs. the United States Electric Company might arrive at any time. It will be remembered that the case, involving the ownership of the patents of the incandescent lamp, was decided in favor of the Edison company in the lower court.

Goodbody & Co., in referring to American Cable stock, state that inasmuch as it is guaranteed by Western Union it seems to them well worth the buying at about 87½.

A Wall street contemporary prints the following relative to the action of the Western Union next Wednesday on the dividend question: "The immediate Gould following is decidedly outspoken in its opinion regarding the chances in an increase in the dividend, and says that the rate will remain unchanged. A plain hint is made, however, at the 'cutting of a melon,' which is construed to mean the division of $14,000,000 surplus among the stockholders. Should the dividend remain unchanged, in our opinion the present price of the stock is high enough, in fact perhaps a little too high. As it is six per cent. stock, 105 would not be too much."

F. C. Gaffney, secretary of the New York Equipment Company, in an interview with a representative of THE ELECTRICAL WORLD, advances the following points relative to street railway interests of the country: "The substitution of electricity for horse power is growing more and more pronounced. Many old horse roads are being made into electric lines, while almost without exception, every new line is equipped with electric power. The building in the South is very limited in extent, while in the North and Northwest it is more or less extensive. The bonds which are placed upon the market to meet the expenses of these improvements are of all classes. A new bond issue of an old road changing from horse to electric power is usually much better than a bond issued to aid in the construction of a new road. The latter class will bear close investigation. As a rule these bonds bear a comparatively low rate of interest."

The copper market for the week showed a decline of a fraction of a cent and closes very weak, with a tendency to further sell off. This condition applies more especially to lake copper, which is largely accumulating, owing to the fact that mining companies have been holding quite firmly at a price above that which consumers are willing to pay. The latter class are doing very little business just at the present time, and by the buying of hand-to-mouth lots, receipt of consignments on contract, and piecing out on electrolytic copper, they have practically been able to decline to make fall contracts. As a result lake copper is quite freely offered at 11⅛ cents, sales are being made at 11.30c. to 11.35c., and the best bid obtainable is about 11¼. Even this figure is offered only for limited quantities. A brief diagnosis of the situation is this: The market is overstocked. Producers are unwilling to unload it at a price which Europeans are willing to pay. They will continue to suffer until such time as they recognize conditions and take preventive action.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Sept. 10, 1892, and the range for the week in New York, Boston and Chicago:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd.
American District Tel....	100	3,825,000	61	61	60	62½
American Tel. & Cable..	100	14,000,000	86¼	87	86	87⅛
Central & So. Am. Tel....	100	6,000,000	....	....	....	....
Commercial Cables.....	100	7,716,000	156	156	158	160
Gold Stock & Tel.....	100	5,000,000	..	....	100	103
Bonds.....	.....	500,000	....	....	100	..
Postal Tel. & Cable.....	...	10,000,000	....	....	62	64
Southern & Atlantic Tel..	25	948,775	....	....	78	84
Western Union Tel.....	100	86,199 852	94⅛	98⅛	97¾	98
Real estate bonds.....	1,000	1,219,000	....	....	....	..
Debenture bonds.....	1,000	4,920,000	..	....	....	....
Collateral Trust 5's....	1,000	8,181,000	103¼	103¾	....	....
North American.....	100	39.767,200	12½	13¼	12⅜	13¼
Brush Ill. Co. of N. Y.....	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y.....	100	6,500,000	100¼	102	102	103
" " Ists.	.....	.....	....	....	...	
Edison El. Il. of Brooklyn.	100	750,000	...	....	85	90
" " " " Chicago..	100	750,000	....	....	130	145
" " " " Boston...	...	.....	....	....	115	125
Edison El. Lt. Europe....1	,000	2,000,000	....	....	2	6
" Bonds....	...	30,000	....	..	65	80
Edison Ore Milling Co....	...	2,000,000	....	....	15	20
East River El Light.....	100	1,000,000	....	....		65
General Electric 1	,000	50,000,000	110	114⅛	113⅞	114⅛
Debenture 5's	...	.....	104½	104⅝	....	....
Automatic Exhibition Co.	...	2,500,000	..	....	3	5
Mt. Morris Electric.....	...	500,000	....	....	....	65
N. E. Phonograph.....	..	2,000,000	....	....	2	4
N. Y. Phonograph	...	2,000,000	....	....	2	5
North American Phonograph.....	...	2,000,000	....	....	4	6
Westinghouse Elec & Mfg. Co. 1st p. 7 per cent. Cum.	50	3,717,253	103	103	....	....
E. & M. Co. Assg.....	50	5.038.116	74	74	74⅛	76

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec.—Series C	sh	40,000	....	....	....	8¾
Thomson-Houston Elec.—Series D	sh	120,000	8¼	....	8	8⅛
Thomson Elec. Weld.. ...	100	1,000,000	....	....	....	....
Thomson European Elec. Weld.....	100	1,500,000	....	....	10	....
Westinghouse Elec.—New Com.	..	6,000,000	38	35	38	38¼
Westinghouse Elec.—Pfd.	..	4,000,000	52½	50	51	51½
General Electric.	..	30,067.200	114½	110½	113⅛	119½
" " Pfd		4,136,300	119	118	119	119½
Fort Wayne Elec.....	25	4,000,000	13	12⅝	12⅝	13
Fort Wayne Elec.—Ser. A.	sh	80,000	8¼	8⅛	8⅛	....
Detroit Elec	10	750,000	7	....	7	....
West End St. Ry. Co.—Com	50	7,150,000	73	72	72¾	73¼
West End St. Ry. Co.—Pfd	50	6,400,000	87¾	87	87⅛	88
American Bell Tel	100	15,000,000	205	202	203	205
Erie Tel. & Tel. Co.....	..	4,800,000	45½	....	45	45½
Mexican Tel. Co.....	10	1,280,000	....	....	1.00	1.15
New Eng. Tel. & Tel. Co..	..	10,304,600	57½	57	57	57¼
Tropical Tel. Co.....	10	400,000	....	....	....	20c.

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stock furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.	Electrical Stocks:	Bid.	Ask'd.
Chicago.....	....	220	Chicago Arc Light & Power Co.....	100⅝	101
Central Union.....	58	59	Chicago Edison Co. ex-rights.....	140	..
Iowa Union.....	20	25			
Michigan	90	95			
Missouri & Kansas..	56	69			

Commercial Cable has declared its quarterly dividend of 1¾ per cent., payable Oct. 1. Books close Sept. 20 and open Oct. 3. It would seem that on the present dividend basis this stock was as high (150 bid, 160 asked) as it ought to go. With sugar common paying 10 per cent. and selling at 112, cordage 12 per cent., quotation 129, and other industries in about the same proportion, any upward movement in Commercial Cable must come from insiders.

Western Union.—As was prophesied by us last week, this stock experienced a pronounced advance, starting from 94¼ on Saturday, reaching 98¼ yesterday, and closing strong at 97¼ to-day. The decline of 10 days ago was occasioned by general depressed market conditions and the refusal of large holders to hold up the stock. The theory is advanced that this class possessed a capacity for considerably more than it held, and was not adverse to picking it up on a declining market. Just at the present time the street is full of points as to what Mr. Gould and his management propose to do in the way of dividing the surplus, increasing the dividends, etc. A meeting to act on the dividend will be held on Wednesday. We are told that Mr. Gould expresses a preference to have the dividends continue at the present rate for a while longer, but says distinctly that he is willing to change his mind if it can be shown to be for the best interests of the company to increase the dividend. It has been reported that Western Union intends to spend $1,500,000 this year for a new building at Chicago, issuing bonds to pay for the same. A director of the company says this is not true, that there has been official talk of erecting a building at Chicago large enough to accommodate its growing business in that city, but that it has been considered inexpedient to attempt to do anything there until after the World's Fair, owing to the present inflated condition of real estate values. Goodbody & Co., in their weekly letter, in reference to Western Union, say: "Western Union got down, as we anticipated it would, to near 93, but it is again strong, and it looks as if the dividend for the year might not improbably be six per cent." Collateral Trust 5's amounting to $6,000 sold at 103¼ during different days in the week.

NEW INCORPORATIONS.

The Electric Light and Power Company, of Van Wert, O., capital stock $50,000, has been formed to furnish electric light, etc. G. L. Marble, L. Melsheimer and F. W. Purmont are the organizers.

The Eagle Electric Company, of Columbia, Ill., capital stock $7,000 has been formed to furnish electric lights for that town. The organizers are Henry Huch, Aug. E. Weinel, Fred Meyer, Wm. Gundlach and Thos. J. Cahill.

The Chicago Electrical Construction Company, of Chicago, Ill., capital stock $150,000, has been formed to manufacture and deal in electrical and mechanical appliances. Wm. H. Passmore, Wm. E. Schofield and Wm. C. Jones are the promoters.

The Dayton & Springfield Electric Railway Company, of Sandusky, O., capital stock $50,000, has been formed to construct and operate an electric railway. John L. Moore, F. F. Hoover, T. B. Taylor, Walter L. Stone and W. H. Gilcher, are the promoters.

The Salem Light and Power Company, of Portland, Ore., capital stock $150,000, has been incorporated to manufacture and sell electric currents for generating and producing light, heat and power. S. Z Mitchell, O. F. Paxton and J. L. Hartman, of Portland, are the promoters.

The El Dorado Gas and Electric Light Company, of El Dorado, Kan., capital stock $40,000, has been formed to furnish water and electric light to the public. W. T. Groom, El Dorado, Kan., A. Gilbert, Sarah M. Gilbert, J. Ketner and S. T. Hall, all of Minneapolis, Kan., are the organizers.

The Santa Cruz Electric Railway, of Santa Cruz, Cal., capital stock $500,000, has been formed to build and conduct a street railway. J. P. Smith, J. H. Logan, F. W. Ely, W. H. Talbot, H. H. Clark, J. G. Tanner, all of Santa Cruz, and Morris Newton, of San Francisco, Cal., are the organizers.

The La Burt Automatic Electric Block Signal System Car Coupler Company, of New York City, capital stock $5,000,000, has been organized to deal in letters patent and to manufacture articles thereunder. W. H. Agricola, John La Burt and A. M. Lowry, all of New York City, are the incorporators.

The Gonzales Electric Light and Power Company, of Gonzales, Tex., capital stock $20,000, has been formed to generate and supply electricity and to furnish electric light, etc. W. S. Fly, E. H. Walker, G. H. Dilworth, T. F. Harwood, M. Eastland, J. C. Jones, W. B. Cave, all of Gonzales, are those interested.

The Queens County Electric Light Company, of Hempstead, N. Y., capital stock $30,000, has been formed to manufacture and use electricity for light, heat and power. Wm. A. Vail, 163 Joralemon street, Brooklyn, N. Y.; Chas. R Truex, Montclair, N. J., and Z. Latshaw, Alhambra, Brooklyn, N. Y., are the promoters.

The Kingston Electric Company, of Kingston, N. Y., capital stock $280,000. This company has been formed by the consolidation of the Kingston Electric Light, Heat and Power Company and the Rondout & Kingston Gas Light Company. Robt. H. Taber, Boston, Mass; Frank B. Slade and Geo. W. Blanchard, New York City, are the incorporators.

The Leffler Electro-Magnetic Railway Company, of Minneapolis, Minn., capital stock $1,000,000, has been formed to manufacture electrical, magnetic and electro-magnetic railways, cars, motors, machines, conduits and appliances. A. L. Brice, P. W. Leffler, F. P. Lane, O. H. Freeman, F. A. Dunsmoor, J. Grienberg, F. F. Reed and N. F. Hawley, all of Minneapolis, are the promoters.

The Seattle Gas and Electric Light Company, of Seattle, Wash., capital stock $1,500,000, has been formed to operate and maintain gas, electric light and power plants, operate, own and dispose of coal and other mines, railroads, etc., deal in electric light fixtures and furnishings, etc. G. M. Nelson, St. Paul, Minn.; Lester Turner, H. G. Struve and R. C. Elliott, of Seattle, Wash., are the promoters.

The Union Telephone Electric Manufacturing Company of New Jersey, of Jersey City, N. J., capital stock $250,000, has been started to purchase patents and patent rights, inventions and improvements relating to and concerning telephone, electric and acoustic appliances, etc. J. J. Kelly, Jersey City, N. J.; L. E. Thorne, J. White, W. I. Slater and H. Leede, of New York City, are the incorporators.

The Sussex Eletric Light, Water and Power Company, of Deckertown, N. J., capital stock $7,000, has been formed to construct and maintain electric light plants or works for the distribution and supplying of electricity for street and interior lighting purposes. J. D. Simmons, E. W. Decker, H. D. Van Gaasbeek, C. A. Wilson, S. M. Young, R. A. Linn, G. L. Lawrence, G. W. Kintner, J. A. Whitaker, T. F. Margarum, O. Harden, W. N. Meeker, A. P. Wood, A. W. Bedell and F. L. Mabie, all of Deckertown, N. J., are the incorporators.

AFFAIRS OF THE COMPANIES.

The Salt Lake Power, Light and Heating Company, of Salt Lake City, Utah, is erecting a brick annex to its plant at a cost of $8,000.

The Crookston (Minn.) Water-Works, Power and Light Company has begun the erection of a new plant a short distance from the old one.

The Beacon Vacuum Pump and Electric Company reports that a company capitalized at $5,000,000 is negotiating to control its patents in Germany, Austria, England and France.

The Marshfield (Wis.) Water, Electric and Power Company has elected the following officers: President, H. Upham; secretary and treasurer, W. H. Fritchman, Peoria, Ill.

The Lowville Electric Light Company, of Lowville N. Y., held a meeting of its stockholders recently to consider the erecting of a new and larger power house, and the addition of some new machinery to better care for its increasing patronage.

Visalia, Cal.—Work on increasing the capacity of the Visalia Gas Light and Heat Company has been commenced. Two 50-h. p. tubular boilers, a new engine, a Thomson-Houston 350-light incandescent and a 30-light arc dynamo will be added. It is expected that Visalia will be lighted by electricity about Nov. 15.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Sept. 12, 1892.

Mr. C. E. Newton, secretary of the Jewell Belting Company, Hartford, Conn., was visiting in New York last week.

Messrs. P. Claus & Co., electrical engineers and contractors, have equipped a factory for building dynamos and motors at 357 West Fortieth street, New York

Mr. Edwin G. Reynolds has been appointed New York representative of the *Street Railway Gazette*, of Chicago. He was formerly superintendent of the Electric Club. He is located at 136 Liberty street, room 607.

The New York Street Railway Association will meet at Saratoga on Tuesday, Sept. 20. The special committee on "Recent Improvements in Electric Traction" will make a report which will, doubtless, be of great interest.

Mr. J. H. Rhotehamel, president of the Columbia Incandescent Lamp Company, of St. Louis, made a pleasant call at the office of THE ELECTRICAL WORLD last week, having with him a large order for the Columbia lamps.

Mr. C. G. Young, formerly superintendent of the Mt. Morris Electric Light Company, and well known for his connection with the production of artistic electric light effects, will on Sept. 17 become connected with Messrs. J. G. White & Co., electrical engineers and contractors, 29 Broadway.

Lighting of the Metropolitan Museum of Art.—The contract for lighting the north wing of the Metropolitan Museum by electricity has been awarded to the New York Electric Equipment Company, for $21,400. This does not include the boiler house and engine room, which forms a separate contract.

Liberty's New Search Light.—The Schuyler Electric Company, of Middletown, Conn., has just received an order from the government for one of the most powerful search lights in the world to be used on the Statue of Liberty in New York Harbor. It will be of 50,000 c. p. and cost about $4,000. It will be similar in construction to the one on Mt. Washington, which was also made by the Schuyler company. The contract calls for its completion by Oct. 1. This company has also a contract for 30 lamps of similar pattern, but less candle power, for use on board United States cruisers.

A Cable to Swinburne Island.—A cable has been laid by the Western Union Telegraph Company between Swinburne Island and the Quarantine boarding station. Considerable difficulty was experienced in finding an operator for the cholera camp on Swinburne Island. A young man by the name of Atkinson finally volunteered. After a short stay there he decided he did not care for that sort of work, and concluded to take his departure, but was somewhat surprised when the authorities informed him that on no conditions would he be permitted to leave the island. L. H. H.

ALBANY, N. Y., Sept. 10.

Dennis Hogan has been appointed superintendent of the Troy City Railroad in place of William R. Bean, resigned.

The Niagara Electric Street Railway is a complete success. From 5,000 to 8,000 passengers a day are carried on the main line and from 1,000 to 2,000 on the Schlosser branch.

The report of the Amsterdam Railroad Company shows the following: Gross earnings, $43,302; operating expenses, $31,247; fixed charges, $5,087; dividends, $2,500; surplus for the year, $4,475; total surplus June 30, $5,546; cash on hand, $1,228.

The Glens Falls, Sandy Hill & Fort Edward Street Railway Company in its annual report for the year ended June 30, 1892, shows the following: Receipts, $33,949.47; operating expenses, $19,440.33; fixed charges, $8,336.74; net profit, $6,172.40.

The Reports of the Buffalo railway companies for the six months ending July 1 show the following: Buffalo Railway Company and West Side Street Railway Company, gross receipts, $145,712.50; Cross Town Street Railway Company, gross receipts, $82,093.70.

The Watertown Steam Engine Company, of Watertown, N. Y., has one of the best equipped plants in the country for manufacturing the types of engines which this company is putting on the market. This company has an isolated lighting plant of 500 Edison incandescent lights.

Superintendent Smith, of the Troy & Lansingburg Railroad Company, made a trip to Boston, New York and Philadelphia to investigate the methods in use by street railway companies during thunder storms. He is experimenting with lightning arresters and a system of grounding which he hopes will result in enabling the company to run electric cars during storms without fear of damage to the power station.

The Albany Railway Company expects to have cars running over the Watervliet Turnpike road by Dec. 1 which will carry freight and express matter. The charter of the old Watervliet Railway Company, which united with the Albany Railway, granted 30 years ago, permits the use of the road for such purposes. It is the intention to establish freight depots at each end of the line, and to start cars hourly both from Albany and Troy. The cars are now being constructed.

The Buffalo, Kenmore & Tonawanda Electric Railway has let the contracts for the construction of that long contemplated line. The Field Engineering Company will do the work, which is to cost $125,000. The road will be eight miles long and will run through Kenmore avenue from Main street to Military road and out Delaware avenue to Young street, Tonawanda. Connection will be made with the Buffalo Railroad Company at Main street and the Military road. The work will be pushed rapidly.

Sale of the Troy & Lansingburgh Road.—The rumor that a New York syndicate had been endeavoring to obtain control of the Troy & Lansingburgh was followed by the purchase of the largest part of the stock by the New York Trust Company. The syndicate secured options on more than 11,700 shares, less than 300 of the full number of shares not being covered. The stock was taken at $225 for each share, par value $100. When the reorganization of the company takes place will be determined as soon as all the stock is transferred. Mr. Charles Cleminshaw is president of the road. The New York Trust Company is the financial representative of Clark, Dodge & Co., of New York.

The Albany Railway in its annual report to the Board of State Railway Commissioners shows the following results as compared with those of last year:

	1892.	1891.
Betterments to road	$114.923	$267,200
Betterments to equipment	497,773	601,166
Gross earnings	263.952	188,588
Operating expenses	161,111	145,555
Income from turnpike	1,940	
Income from N. E. & G. R. R.	162	
Fixed charges	59,215	33,123
Dividend, 6 per cent	45,000	
Surplus for year	566	10,072
Total deficit June 30	16,166	16,732
Passengers carried	5,177,814	3,789,378
Persons injured	10	
Persons killed	2	

The entire equipment of the North & East Greenbush Railroad Company, less cars and old material, cost the Albany Railway $20,251.83. Besides this the company had to assume the bonds of the Greenbush road at 5 per cent. to the extent of $30,000, which mature in 1911. R. V. T.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Sept. 10, 1892.

The Shawmut Fuse Wire Company, of Boston, Mass., has issued a handsome and profusely illustrated catalogue.

Mr. B. E. Davis, representing Pass & Seymour, is at the Hub, and reports that he is getting his share of the trade. He paid a pleasant visit to this office.

The Perkins Lamp Company, of Manchester and Boston, is talking of bringing out a new lamp called the "Corbett," because of its long life and high efficiency.

Messrs. Waterhouse Brothers, of Hartford, Conn., have been forced to add to their present manufacturing facilities on account of the increased demand for their arc lamps, and have rented additional space in the building now occupied by them.

The Pettingell-Andrews Company, of 192 Summer street, Boston, is carrying a large line of first class electric light specialties and is preparing to push vigorously its electric railway supplies, having added by the purchase of the Eastern Electrical Supply Company a considerable number of patented devices that are extensively used in street railway work.

Cambridge, Mass.—At the first meeting of the Cambridge city government after the summer adjournment a petition from the Storage Battery Street Railway Company was presented, asking for track location on several of the prominent streets of the city. Arguments were presented by various experts and interested parties both for and against the petition. The matter was referred to the committee on street railways.

The Eddy Electric Company, of Windsor, Conn., has about completed its new factory, which is a duplicate of the original one, which at the time of its construction was expected to accommodate the business of the company for years, but the growth of the business has been so rapid that the company was compelled to increase its facilities. The steam plant consists of Roberts (Cambridgeport) boilers and Ball & Wood engines. An Acme engine will furnish the power for ventilating fans. The company is now completing a number of very large generators for the World's Fair.

The point at issue between the Newton & Waltham Street Railway Company and the Watertown selectmen has at last been settled, and the street railway company has been given a franchise to lay tracks on Main street from the Waltham line to the square at Watertown. The selectmen refused the location on the ground that the road was too narrow near the Heatherstone estate, but after the company had made unsuccessful advances to Mr. Heatherstone for the sale of a portion of his land bordering on Main street for the widening, the Selectmen reconsidered their vote and granted the desired location. The road, when finished, will complete a circuit, connecting Newton, Waltham and Watertown.

The Safety Brake Shoe and Construction Company has opened offices at 620 Atlantic avenue, Boston, with Mr. Wm. W. Whitcomb, formerly secretary of the American Steel Car Wheel Company, as president and general manager. Mr. W. B. Ferguson, well known in electrical circles, is the vice-president. The brake shoe which this company is introducing is the invention of its superintendent of construction, Mr. D. N. Cork, and is cast in two parts, the head being fastened so as to become a fixture of the truck, while the face is secured to the head by keys or bolts. The face is cast with holes into which a wooden plug is driven giving a bearing surface against the wheel of wood and iron, and a grip of two-thirds more power, it is claimed, than any other similar shoe. The stopping of a car is thus done very quickly, and the jumping when the brakes are set is overcome as well as the sliding of the wheels on the rails,

A most important hearing has been held before the Malden aldermen. The hearing was on the petition of the West End Street Railway Company for permission to maintain poles, wires, etc., with the view of equipping its plant with the necessary appliances for running its cars through Malden by electricity. Malden has always wanted a five cent fare to Boston, and as the cars can run from that city to Boston by electricity in 35 minutes, the aldermen decided to demand a five cent fare in return for granting the required permission. The fare is now eight cents. In addition to this, the local fares are now complicated. The road was represented by Mr. Henry D. Hyde. He said that if the permission was granted, work on the equipment would be started at once, and the cars would be running by electricity this fall. In speaking of the complicated fares he said that in order to change fares the permission must be granted by the legislature. If the aldermen granted the permission, the road would petition the legislature, jointly with Malden, for a five cent fare between Malden and Boston. If Medford granted the company's petition, there would also be a five cent fare from Boston to Medford. It is the plan of the road to make two main roads out of what is now a circuit road. One main road would be from Boston to the Malden depot, and the other from Boston to Medford square. The fare on each of them would be five cents. It was then proposed to make the lines running from West Medford to Malden one line, the fare from the Malden depot to West Medford being five cents. It was also proposed to have double tracks through Everett, which would thus give a continuous double-track line from Malden to Boston. The board took the matter under advisement, but will probably grant the petition when the West End draws up the order. W. R. W.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Sept. 10, 1892.

The Standard Electric Company, Chicago, now has orders on its books for some 53 arc light machines to be delivered within the next 60 days.

Mr. Elmer A. Sperry, who was so unfortunate as to break his collarbone a short time since, is around as usual, and shortly will have full use of his arm.

Mr. George A. McKinlock, treasurer of the Central Electric Company, has gone abroad for a month's vacation, and will visit Ireland, Scotland, London and Paris.

The National Electric Manufacturing Company has removed its Chicago office from 931 The Rookery to 608 Pullman Building, where it is represented by Mr. Paul W. Bossart.

The Chicago Telephone Company has purchased a lot on the southwest corner of Pacific avenue and Harrison street for the sum of $165,000. A fine telephone building will be erected on this block.

The National Electric Manufacturing Company, of Eau Claire, Wis., through its agent, Mr. Paul Bossart, has sold five alternating incandescent light machines so far this month in Chicago.

The Western Electric Company, of Chicago, has secured the contract for the entire electrical installation at the New York State Industrial school, at Rochester, N. Y. It has also received a large number of orders for electrical lighting apparatus.

Mr. H. P. Barr, general manager of the Sperry Electric Railway Company, with headquarters at No. 29 Broadway, New York, has been passing several days with the Sperry officials in this city arranging for the placing of the Sperry electric railway system on the market at once.

The Western Union Telegraph Company, of Minneapolis, Minn., has moved into its new quarters at the corner of Third street and Hennepin avenue. For several years the company has been very much cramped for room, but the new quarters are very commodious and conveniently arranged. The work of transferring the entire system was done without any break in the regular service.

Mr. W. Oesterlein, of Cincinnati, O., the manufacturer of the well known Oesterlein clutch, has recently removed to larger quarters on account of the increase in business. These clutches are now being used in many parts of the country, and are reported to work with entire satisfaction. The Lodge Davis Company alone takes 50 sets per month, and large orders have recently been filled for Milwaukee, Oshkosh and other cities. Power transmission machinery is also manufactured.

The Central Electric Company has taken the agency for "Machines for painting moldings," recently illustrated in the electrical papers, and manufactured by the Standard Paint Company, of New York City. These machines will now be handled by the Central Electric Company, or any of its branches, the Southern Electrical Supply Company, at St. Louis, Mo.; Gate City Electric Company at Kansas City, Mo., and the Western Electrical Supply Company at Omaha, Neb.

Among the World's Fair visitors this week were: J. H. Rhotehamel, president Columbia Incandescent Lamp Company, St. Louis, Mo.; Mr. E. L. Babcock, president, and Mr. H. C. Stambaugh, secretary of the Falls Rivet and Machine Company, Cuyahoga, Falls, O.; Mr. Eugene C. Sickles, formerly with the Wenstrom Electric Company in Baltimore, and now *en route* to Des Moines, Ia., where he has accepted the chair of electrical engineering in the Highland Park Normal College; Mr. G. P. Altenberg, the Cincinnati representative of the National Electric Manufacturing Company, Eau Claire, Wis.; Mr. A. D. Adams, of the Jenney Electric Motor Company, Indianapolis, Ind.

The Midland Electric Works has opened a fully equipped shop at 224 East Washington street, Chicago, for the manufacture of models, and the developing of the ideas of electrical inventors, the intention being to quickly and economically put into shape any good idea that an inventor may present, thus assisting him in placing it in so presentable a form that its commercial value can be more readily appreciated. The company is also securing contracts for manufacturing electrical specialties and piece work, having already been intrusted with some work by large electrical supply houses. It will also manufacture small motors, dynamos and plating machines to order. Mr. Ray Griggs is the president of the company and Mr. C. F. Samms secretary and treasurer.

Municipal Lighting.—Mr. J. E. Webster, 231 Gilman street, Madison, Wis., will respond in the negative in a joint debate at the Wisconsin University on the question: "Would municipal ownership and operation of lighting works and street railroad lines be preferable to private ownership and operation in cities in the United States of 25,000 or more inhabitants?" The interpretation being: (1.) "Municipal operation" to mean direct and absolute management by the cities themselves through their officials. (2.) "Lighting works" to mean gas works and electric light systems. (3.) "Street railroad lines" to include all those means of transportation on rails which are organized exclusively for urban and suburban traffic. Central station managers can no doubt add much to the value of this debate by supplying Mr. Webster with any data they may have at their command, that will enable him to more fully present his side of the question. F. DE L.

TACOMA, Wash., Sept. 5.

Leo Daft, of Seattle, has installed an electric light plant, an air compressor and Burleigh drills at the Johnson mine, near Granite, in Snohomish County, Wash.

The Bellingham Bay Line of electric street railway, at New Whatcom, Wash., has been reconstructed, and the roadbed ballasted. Greatly improved service is the result.

The Olympia Light and Power Company's new electric line in Olympia, Wash., is completed and in successful operation. The company's light and power plant is valued at $250,000.

The incandescent lighting station of the Washington Electric Company, which was bought out by Fred. E. Sander, has been shut down, and the circuits are now run in connection with those of the Union Electric Company.

The Rainier Power and Railway Company, of Seattle, has erected a new power house at the corner of Almy and Albert streets. The company's new line, to Ravenna Park is practically completed and cars have been run over the line.

The Rainier Power and Railway Company's new lines under contract with Chas. H. Baker & Co. are nearing completion. The lines are completed to Third street, in the centre of the city of Seattle, and will soon be opened with some ceremony.

The Cook Electric Line, of Spokane, Wash., has received four new cars, one having Short equipment and the remainder Thomson-Houston. Mr. O. De Camp, formerly superintendent of the Spokane Street Railway Company, has been appointed superintendent of this line.

The Columbia Land and Improvement Company has commenced the construction of an electric railway on North Main street, in Vancouver, Wash., which will probably be extended to the race tracks above the town this fall. The power house will be erected on the river front.

Fred. E. Sander, of Seattle, has just had a franchise granted him by the King County Commissioners for the extension of his Grant street electric line from its present terminus in South Seattle along the county road to Braun's brewery. It will be extended thence to Tacoma as soon as possible.

The Tacoma Railway and Motor Company has beaten

its record in handling the Exposition traffic, running a three-minute service to the building. Ten new Thomson-Houston w. p. 30-h. p. car equipments have been received. An electric line westward to the Narrows is among the probabilities as to the company's next extension.

The National Tramway and Electric Lighting Company, of Victoria, B. C., lost $200,000 by the fire which destroyed the power house. Insurance $50,000. F. H. Osgood, of Seattle, president of the company, has purchased four new dynamos, which are now being installed. The capacity of the new station equipment is 3,500 lights.

The Western Washington Industrial Exposition building, in Tacoma, is being lighted this year by a plant exhibited by the Tacoma Light and Water Company. Three Thomson-Houston arc machines of 50 lights capacity each are used to run Thomson-Houston and American lamps. Two Edison dynamos operate 1,000 incandescents.

The Union Railway Electric Company, of Everett, Wash., has been organized with a capitalization of $200,000 to give Everett a street railway and lighting system. Lines to Lowell from the Barge Works and to Snohomish are also comprehended in the scheme. J. B. Hawley, is president; M. Stewart, vice-president; Geo. S. Brown, secretary, and W. G. Swalwell, treasurer. Joseph L. Colby is expected to furnish the capital.

The Seattle Gas and Electric Company will extend its electric lighting system and pursue an aggressive policy. A two story brick building, 150 by 75 feet, will be erected near the present station. The engines will be placed on the ground floor. Two arc machines, in addition to the five fifty-light dynamos now in use, will be placed on the second floor, and an incandescent plant of 1,500 lights capacity will also be added at once. John Mather is the new general manager.

The Sunset Telegraph and Telephone Company has repaired its lines which were cut by the Northern Pacific Railroad Company where they encroached on its right of way between Tacoma and Portland. The line is now working as far as Kelso, and construction is being pushed. Gray's patent telephone pay station has been introduced in Tacoma. The company has 900 instruments in use in Seattle. The line has been extended from Columbia to Brighton Beach.

The Great Northern Railway Company has renewed the lease to the Western Union Telegraph Company of the Great Northern's telegraph lines, including the Pacific extension to Seattle. The Western Union now operates the lines as far west as Spokane, except those on the Montana Central, along which there is not enough business to warrant stretching an extra wire for commercial purposes. It has been denied that the Great Northern would operate its own telegraph lines along its main lines.

The Spokane Street Railway Company, of Spokane, Wash., has purchased the City Park Transit Company's franchises over East Sprague street, Third street, Hatch street and parts of Monroe and Pine streets. It has also obtained a controlling interest in the Ross Park Street Railway Company, which runs about four miles east of the city through the Ross Park addition on the north side of the Spokane River. The company now controls almost entirely the street railway business in the city, having seven lines equipped with 32 cars.

The Sunset Telegraph and Telephone Company is pushing its new line from Tacoma to Portland, which will probably be completed this month. A gang of men is working from Kalama toward Vancouver. Another gang has laid a cable a mile in length across the Columbia River at Vancouver, and is proceeding northward toward Kalama. The line between Olympia and Tenino has been rebuilt. The company has built a double metallic line, 13 miles in length, for the Point Defiance, Tacoma & Edison Railway Company. A telephone is to be placed on each car to report trouble at every twelfth pole.

G. R. De V.

CANADIAN NOTES.

OTTAWA, Sept. 10, 1892.

Yarmouth, N. S.—This town has been the first to have an electric street railway system in operation in the Maritime Provinces.

Victoria, B. C.—A by-law by which it was proposed to raise $60,000 to increase the electric street lighting service of this city has been defeated.

Leamington, Ont.—Voting took place here successfully last week upon a by-law for the purpose of raising $5,500 with which to purchase an electric light plant to be operated by the corporation in connection with the water works.

Toronto.—The by-law to give a bonus of $20,000 to the Toronto & Richmond Hill Electric Railway through that portion of York township immediately to the northwest of the city limits has been carried by a large majority.

Kingston, Ont.—Negotiations between the city and the street car company with reference to the introduction of electricity are not at an end, as many suppose. It is altogether likely that a new contract will be drawn up, more satisfactory to the company and more reasonable in its exactions than the one recently submitted.

Montreal.—Montreal will likely get cheap electric light when a new tender is aked for, which will be about November. Already three large electric light companies of the United States have sent on for specifications and three or four organized Canadian companies besides the Royal Electric are anxious to get the contract.

Ottawa, Ont.—It appears to be the intention of the horse car and electric street railway companies to allow the proposed change from horse power to electricity to drop. The proposal of the committee for the payment of $800 and 10 per cent. of the receipts at the expiration of 20 years was considered a first class thing for the corporation, but quite the reverse for the company.

Toronto.—The new electric street car line along the Davenport road out to Carleton and Toronto Junction is nearly completed, and trains will in all likelihood be running on Monday next. The line runs from the head of Bathurst street along the Davenport road to Carleton and Toronto Junction and then southerly to a junction with the Mimico line. Over $100,000 is being spent in construction.

Victoria, B. C.—The directors of the Electric Tramway and Lighting Company have let the contract for the erection of the new power house and buildings, and work is to be commenced immediately, and rushed forward as fast as possible. The president of the company, Hon. D. W. Higgins, says he is confident that within a month at the outside the cars and lights will again be in operation. The arbitrators and adjusters who have been settling up the claims under the various insurance policies concluded their labors yesterday. The face value of the policies was $51,000 and the company receives $38,000 in cash and all the machinery, etc., which is classed as salvage.

Toronto.—A hitch has occurred in the negotiations between the Toronto and Scarboro Electric Lighting and Street Railway Company and the township council of York. The company recently applied for the right of way, in a westerly direction, along the Danforth road beyond the intersection of Greenwood avenue. The council also object to the manufacture and introduction of an electric system of street lighting within the township limits, and insist upon binding the company to complete the railway, upon the limits assigned to them, within two years. It is decided to adopt a new line of route, viz., along the Kingston road to the Woodbine, and thus to establish a direct system of street lighting and railway communication between the city and East Toronto village.

Hamilton, Ont.—A survey has been made for the purpose of determining the cost of constructing an electric railway between Hamilton and Guelph, a distance of 26 miles. From Guelph to Freeland, 12 miles, there is a blind line running parallel to the Brock road, level from end to end, and the owners of property along this blind line will give it free for the purpose of an electric railway. From Freelton the road could be diverted to take in Carlisle or Milgrove, or both, without lengthening the line, and from the latter place an easy grade is found in the bed of the creek, running through Waterdown down to the Hamilton level. An examination of the ground shows that the Waterdown and Hamilton grade between these two places to be overcome is about 350 feet, and by using the creek bed there would be about seven miles of track in which to overcome the rise.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Aug. 30, 1892.

Samuel Varley.—A letter has been extensively circulated among the electrical profession setting forth the claims to substantial recognition of Mr. Samuel Varley, who is considered by many eminent authorities as the undoubted inventor both of the self-excited and the compound wound dynamos.

Submarine Telegraph Relays.—The French papers, technical and non-technical, have been giving currency to a statement that a French electrician, M. Willot, had devised a relay, which enabled Paris and Algiers to be placed in direct telegraphic communication by means of Wheatstone and Hughes apparatus. I believe this is actually the case, but the maximum speed realized up to the present is not exactly excessive, amounting, as it does, to one word every 15 seconds.

Lighting of the City.—Nearly 200 arc lamps are now in regular operation in the streets of the city of London, and it is expected by the middle of next month that the greater number of the lamps contracted for (about 600) will be in operation. The demand for current continues greater than was anticipated. On the 30th of June last signed applications had been received for over 32,000 lights, and at the present moment the public and private lamps installed are earning money at the rate of £14,000 per annum.

An Electric Shunting Engine.—Messrs. Mather & Platt, of Salford, have recently constructed a heavy electric locomotive for use at some large iron works in Sweden. This locomotive is built for working with an electromotive force of about 300 volts, and in outward appearance is very similar to the locomotives on the City & South London Railway. The motor is of the double armature type, the armatures being connected to the axle through a 10 to 1 speed gearing. The current is collected from an overhead wire 16 feet from the rails, the collectors consisting of an iron bar at each end of the locomotive, carried on upright pipe pillars.

Board of Trade and Electric Meters.—Under the Electric Lighting acts all electric meters have to be approved by the Board of Trade, and owing no doubt to the comments which have arisen as to delay in approval of different types of meters, the Board of Trade have sent a letter to the London County Council stating that it is their intention that further experience of the behavior of meters should be gained and further inquiry made before formal approval of any particular type is given, since it has come to the knowledge of the department that several meters which had given satisfactory results in the government laboratory have developed defects in actual working on the consumers' premises.

Overhead Wires in Lodonn.—The regulation of the ever-increasing number of overhead wires in London has engaged the attention of the London County Council for some years past. Several drastic bills have been placed before Parliament and uniformly rejected. Finally, however, a moderate bill was passed and some regulations drawn up and published at the end of last year. The regulations, like the bills, were not generally accepted; the Board of Trade was petitioned and at the end of last month the regulations, as amended by the Board of Trade, at last came into force. These by-laws contain no features worthy of remark, all the controversial points having been eliminated by the Board of Trade.

Fire Insurance Offices and Electric Lighting.—On the occasion of the recent Electrical Exhibition at the Crystal Palace, the fire insurance offices, in spite of the fact that the Crystal Palace had retained Mr. Musgrave Heaphy, of the Phœnix Fire Office, as their consulting electrical engineer, temporarily raised the insurance premiums at the Crystal Palace. This fact was much commented on at the time, and was not unnaturally considered by the gas journals as a practical answer to the claims of electrical engineers to perfect safety. It is on the face of it, therefore, somewhat contradictory to learn that the fire insurance offices have now agreed to lower the insurance premiums at the Crystal Palace, if the Palace authorities will go to the expense of fitting the theatre throughout with the electric light and automatic sprinklers.

Accumulator Car Traction.—The financial results of the half dozen or so accumulator cars, which came into operation some two years ago on the Bristol Road line of the Birmingham Tramway Company's system, have been watched with some attention, as no pains were spared to make the undertaking a success, in the hope that if successful, local authorities might be induced to look more favorably on accumulator traction. In the directors' report for the year ending June, 1892, however, the oft told tale of failure is repeated, the cars having worked during the last 12 months at a loss of nearly £1,700; a loss which is said to be chiefly due to the heavy cost of battery renewals. During the year in question the total receipts were £12,101, and 188,760 car miles were run and 1,382,997 passengers were carried, the total cost of accumulator traction per car mile coming out at 15.39d. as against 12.03d. for steam cars, 9.96d. for the horse cars and 6.18d. for the cable cars. It must not be forgotten, however, that the scale upon which accumulator traction is carried out at Birmingham is incomparably smaller than in the case of its competitors. A still more severe blow to accumulator traction has been the peremptory stoppage at the end of last month of the accumulator cars running on the Barking Road section of the North Metropolitan Tramway Company's system. The contract price was originally 4½d. per car mile for three years. At the end of the three years the price was raised to 5½d., and as the time for the termination of this latter contract approached the contractors demanded 7½d. per car mile. This figure, to which the tramway directors could not accede, was ultimately compromised by the directors acceding to 6½d. per car mile. Before this come into force the tramway company, finding that the running of the cars grew more and more unsatisfactory, determined to abandon the experiment.

News of the Week.

THE TELEPHONE.

A telephone line from De Kalb, Ill., to Sycamore and St. Charles, to connect with the Chicago line, is being discussed.

Brookfield, Mo.—A franchise for 10 years has been granted to Messrs. Hair & Crampton to erect a telephone line to connect Brookfield, Marceline, Linneus and Laclede. Work will commence at once.

THE ELECTRIC LIGHT.

Niles, O., is considering an extension of its electric light system.

The Orange City (Ia.) Electric Light Plant is now in actual operation.

Leamington, Mich., has voted $5,500 for the purchase of an electric light plant.

Shell Lake, Wis., is making a strong effort to organize an electric light company.

Elmwood, Ill., will soon add a 1,000-light incandescent dynamo and a 150 h. p. engine and boiler to its plant.

Ottumwa, Ia.—An electric light company is being organized by the owner of the electric light system of Albia.

Hampton, Ia., by a vote of 191 to 3 has decided in favor of an electric light plant, which will be erected at once.

Savannah, Mo., has let the contract for an electric light plant. Five hundred incandescent and 40 arc lights will form the equipment.

Rahway, N. J., is advertising for bids for the lighting of its streets. No less than 300 incandescent lights or fifty-four 2,000-c. p. arc lights will be required.

Omaha, Neb.—A quiet effort is being made to put in an additional electric light plant, and it is understood that the new company will be under the supervision of Joseph F. Smith.

Waverly, Ia., has passed an ordinance authorizing the Waverly Electric Light Company to erect, construct, maintain and operate electric light, heat and power works in the city of Waverly.

Baltimore, Md.—The Park Board has decided to place electric lights around the large lake in Druid Hill Park. As this is a very popular drive, this improvement will undoubtedly be acceptable to the public.

Newport, Vt.—It is reported that a water power privilege with a building site has been purchased near the high bridges, with the intention of erecting an electric light plant to light the villages of Barton and Barton Landing.

Quakertown, Pa.—The contract for the erection of the new electric light station has been awarded to M. H. Biehn. The building will have a corrugated galvanized iron roof, and an 18-inch wall. It is to be completed by Oct. 15.

The Utica Electric Light Company, of Utica, N. Y., has recently made several changes in its central station, having installed a new Hamilton-Corliss engine and changed the arrangement of its power house, placing in a new switchboard, etc.

Clinton, Mich., at a special election held Sept. 3, by a vote of 118 to 49 decided to bond the village for $8,000 for an electric light plant. One 500-light incandescent dynamo, a 30-arc light machine, a 50-h. p. engine and a 65-h. p. boiler will probably constitute the equipment.

The Moscow (Wash.) Electric Light and Power Company has started up its new plant, which is now operating successfully. The plant consists of one 150-h. p. boiler, one 125-h. p. Russell-Carlisle engine, one 50-light Thomson-Houston arc dynamo, and one 650 Thomson-Houston alternator. In connection with this the company has the old plant at the planing mill, consisting of one 50-light Edison arc light dynamo and one 500-light Edison incandescent machine. This will be removed to the new building.

THE ELECTRIC RAILWAY.

Chicago, Ill.—A movement is on foot to construct an electric line on Forty-seventh street from Cottage Grove to Western avenue.

The Naumkeag Street Railway, of Salem, Mass., will build its power station on Laboratory street this fall. It will be of brick, one story in height. The plant will eventually consist of 10 dynamos of 500 h. p. each.

The Rockland, Thomaston & Camden (Me.) Electric Railroad, which was originally intended chiefly for a freight road, has happily disappointed its projectors. It is reported that over 140,000 passengers were carried during the first month.

The East Side Railway Company, of Portland, Ore., will have its line to Oregon City completed within 60 days, making an electric line of 13½ miles. This company has recently purchased the entire plant of the Mount Tabor Street Railway Company.

Chicago, Ill.—A contract for the construction of the track work on the Twenty-second street electric line has been let to Gaffney, Long & Quaid. The rails contract has been given to the Pennsylvania Steel Company, of Philadelphia, and 80-pound rails are to be used.

The Watertown Street Railway Company, of Watertown, N. Y., has recently completed a new car barn which will be ready for use in a short time. It is a neat and substantial brick and stone structure, and is arranged to furnish the company with large, light offices.

Oshkosh, Wis., has granted a franchise to the Oshkosh Electric Railway Company for 50 years. The overhead trolley system is to be used, and the company is to pay an annual license of $1,000, besides agreeing to carry passengers between six and seven o'clock in the morning and evening for a fare of three cents.

The South Chicago City Railway Company is pushing the work on its electric station on Ninety-fifth street, preliminary to changing its entire service from horses to electricity. Right of way has been granted for the extension of the road north of Stony Island avenue to Sixty-seventh street, where a connection is to be made with the Alley "L" road.

The Metropolitan Traction Company, of New York, has applied to the Board of Aldermen for permission to build new tracks on Lexington avenue above Twenty-third street to connect with the Houston, West street and Pavonia Ferry Company's route, and also to lay tracks on Lexington avenue above Forty-second street to the Harlem River. It asks permission to use any kind of motive power except locomotive steam power.

Camden, N. J.—The work of changing the Old Daft two-wire road over into a single trolley line has been completed, and an ex-

tension of 2¼ miles in length has been constructed to Merchantville. The current is still taken from the Thomson-Houston electric light station, but the new power house is expected to be finished about the first of October. If this line is successful, as it undoubtedly will be, the other roads in Camden under the same control will in all probability be similarly equipped. J. Stanford Brown is the engineer in charge of the work.

LEGAL NOTES.

Duties of Telephone Companies.—Telephone companies are subject to the rules governing common carriers, and are bound to furnish equal facilities to all persons or corporations belonging to the classes which they undertake to serve. They are not exempt from this obligation by the fact that the instruments by which their business is carried on are patented, for while a patentee has a perfect title to the thing patented, and its use, and is not bound to apply it to a public use, yet when he does so he is bound by the rules governing such use. This decision was rendered in the Circuit Court of Appeals, Third Circuit, in the case of the D. & A. Telegraph and Telephone Company vs. the State of Delaware.

Effect of Other Decisions on Protection of Patents.—Where letters patent have been twice sustained in another circuit a preliminary injunction against infringers will issue, as a matter of course, and such injunction will not be denied because of affidavits of alleged new evidence in respect to anticipation, especially when it appears doubtful whether such evidence was not known to the defendants in such prior cases and that the defendant corporation herein was closely allied with the corporations defendant in the prior litigation, and contributed to the expense thereof, either directly or through its individual stockholders. Where, however, such injunction will seriously affect defendant's business, and it appears that an appeal has been taken from the decisions in the other cases, the court will require the complainants to give bond to secure payment of damages in case the injunction is subsequently dissolved. This decision was rendered in the case of the Brush Electric Company vs. the Accumulator Company in the Circuit Court, District of New Jersey.

Warranty of Machines.—Where a purchaser orders a certain machine by letter, stating that it is to do specific work, and the seller answers, accepting the order, and stating, "You may rely on having a first rate machine, which will do your work in a satisfactory manner," these last words are not mere words of commendation, but are to be construed as part of the contract, and constituting a warranty. And where a machine is purchased from an English manufacturer under a warranty that it will do certain work in America, the measure of damages for breach of the warranty is the difference between the contract price of the machine and its value in America to the purchaser, including expenses incurred by the purchaser for alterations and changes made on the machine in order to get it to do the work for which it was purchased. This was a decision rendered in the case of the Whitehead & Atherton Machine Company vs. Ryder, in the Supreme Judicial Court of Massachusetts.

Liability for Injury from Suspended Telephone Wire During an Electrical Storm.—A telephone company which for several weeks permits its wire to remain suspended across a public highway, a few feet from the ground, is liable to a traveler who comes in contact therewith during an electrical storm, and is injured by a discharge of electricity. The duty on the part of the telephone company was clear to prevent its wire from becoming an obstruction on the highway. The person might have been hurt by coming in contact with the wire of the telephone company, and injuries to him might have resulted, independent of the fact that the wire at the time was charged from the storm then prevailing. Moreover, persons must be held to know the ordinary operation of the forces of nature, and to use proper means to avert danger. To say that the agency of the telephone wire in the production of the injury was inferior to that of the electric current, which was the main cause, is not satisfactory. It is, in fact, to admit that the company's displaced wire furnished the means by which the dangerous force was communicated to and injured the defendant in error. True, it was a new force of power which intervened, with the production of which the telephone company had nothing to do; still the new force here would have been harmless but for the displaced wire and the fact that the wire took on the new force, with the creation of which the company was not responsible, though it contributed no less directly to the injury on that account. This decision was rendered in the case of the Southwestern Telegraph and Telephone Company vs. Robinson in the United States Circuit Court of Appeals, Fifth Circuit.

PERSONALS.

Mr. A. D. Newton, general manager of the Eddy Electric Company, of Windsor, Conn., is taking a few days' rest at Bethlehem, N. H.

Mr. Ralph Stone, editor of the *Michigan Law Journal*, has formed a partnership for the general practice of law with Mr. Byron M. Cutcheon under the firm name of Cutcheon & Stone, with offices in the Michigan Trust Building, Grand Rapids, Mich.

Mr. Nikola Tesla, whose name has become a household word among electricians the world over, has returned to this country ahead of the cholera. While in Europe Mr. Tesla made several important business arrangements. He has now resumed his experiments in this city.

Prof. H. S. Carhart, of Ann Arbor, who has been spending his vacation in Europe, was a passenger on the Guion Line steamer Alaska, which has just reached New York. Prof. Carhart enjoyed his European visit very much, and returns to his important work at the University of Michigan greatly refreshed and benefited by his travels.

MISCELLANEOUS NOTES.

A Correction.—In THE ELECTRICAL WORLD of Sept. 3, 1892, page 147, mention was made of several 100,000 light Westinghouse dynamos. This was a mistake, as the largest size to be employed is of 20,000 light capacity.

The New York Submarine Cable and Telegraph Company, which was recently incorporated with a capital stock of $10,000, proposes to construct and operate a cable line between New York and the West Indies, the extreme points to be connected being New York, Cuba and San Domingo.

An Electrical Banquet.—A very interesting banquet recently took place at Ottawa at which every item on the bill of fare was cooked by electricity. The electrical oven used was the patent of Mr. T. Ahearn, of the firm of Ahearn & Soper, of Ottawa. It was unanimously decided that this method of cooking was an entire success.

"Rare and Useful Information for Travelers, Mechanics and Railroad Men" is the title of a very useful little book which is compiled by Mr. T. J. Nicholl, of Chicago, and published by Danks & Co., of the same city. This is the second edition of this book. It contains a great deal of useful information of value to mechanics and all classes of engineers, but is specially designed for railway men. Such a collection of facts and figures in such a convenient form is always an aid to the engineer.

The Chicago & St. Louis Electric Railroad Company has issued the prospectus of the proposed electric line between St. Louis and Chicago. A very interesting description is given both of the construction of the road and of the country through which it passes. This interesting line was thoroughly described in THE ELECTRICAL WORLD of June 11, 1892, and all of the cuts used in that article have been here reproduced, while a number of others giving views of the bridges and terminal stations, besides maps showing the route and the feeding lines, have been added.

Data Concerning Platinum.—So universal has become the use of platinum and so essential is it in the various commercial applications of electricity that any information concerning the properties of this useful metal will be gratefully received by the electrical public. It has been practically impossible in the past to obtain any reliable data, and whatever has been known about platinum has not been in a form accessible to the ordinary engineer. Baker & Co., gold, silver and platinum refiners, of Newark, N. J., have just issued a little pamphlet entitled "Data Concerning Platinum, etc.," which is intended to fill this long felt want. It contains very complete tables giving the weight per foot of platinum wire in Troy and French weights and the weight per square inch of platinum sheet or foil, besides other information which is of practical value. This little book will undoubtedly prove extremely useful, not only on account of its real value, but because it contains matter which cannot be conveniently found elsewhere.

Industrial and Trade Notes.

The Perkins Switch Company, of Hartford, Conn., reports business as very active.

The Mountain Electric Manufacturing and Construction Company held a grand opening at its works at Meyersdale, Pa., on the evening of Sept. 10.

Mr. Charles Wilson, Northwestern representative of the Babcock & Wilcox Boiler Company, has secured the contract for supplying the 200-h. p. boilers required at Owatonna, Minn.

A. D. Adams, traveling representative of the Jenney Electric Motor Company, has called upon the World's Fair officials in reference to supplying electric motors in the various buildings.

The Electric Appliance Company, of Chicago, reports great activity in all lines of its business, and especially in the case of the Elkhart transformer, which it has lately placed upon the market.

Huebel & Manger, 286-290 Graham street, Brooklyn, have issued a neat little catalogue telling all about the new electric bell they recently put upon the market, and which was described in THE ELECTRICAL WORLD of Aug. 12, 1892.

Messrs. G. A. Grant & Co., 8 Oliver street, Boston, Mass., has made an important sale of a 250-h. p. McIntosh & Seymour engine to the Chelsea Gas Company, of Chelsea, Mass., and has filled a duplicate order for the Lawrence, Mass., Gas Company.

The Sperry Electric Mining Machine Company, Chicago, is finding ready sale for its fuse wire in foreign lands as well as in this country, and is now shipping a quantity drawn for use on circuits supplying fractional parts of an ampère of current.

The Utica Electrical Manufacturing and Supply Company, of Utica, N. Y., reports business as very brisk. This company is manufacturing a line of electrical goods which are very popular, and will soon have several new specialties to offer the trade.

Messrs. Waterhouse Brothers, Hartford, Conn., have issued a very attractive little catalogue setting forth the advantages of their arc lamps. These lamps have the well known atmospheric clamp clutch feed, and are adaptable both for incandescent and arc circuits.

The Bishop Gutta-Percha Company's illustrated catalogue and price list has recently appeared. This company, which is located at Nos. 420-426 East Twenty-fifth street, New York, manufactures about everything in the line of wires or cables of a uniformly high standard.

The Brown & Sharpe Manufacturing Company is sending out its annual catalogue. The work of this company is too well known to need any mention. It manufactures all kinds of milling and planing machinery, fine machine tools, gears and castings and standard rules, wire gauges, etc., all of which are illustrated and described in this catalogue.

J. Bradford Sargent has recently sold to Charles Heap, of Williamstown, Mass., one 150-h. p. Cooper-Corliss engine and one 300-h. p. Stirling water tube safety boiler. The Stirling company has just issued a handsome pamphlet, giving the names of several hundred concerns which have installed its well known boilers, and among the list are many electric plants.

Mr. J. H. Cooke, the Chicago agent of the Buckeye Electric Company, has sent out a very suggestive blotter, having on its face this query, "What is the difference between this blotter and a Buckeye lamp?" The answer reads, "The blotter blackens with use; the Buckeye don't." Mr. Cooke is also sending out an attractive little folder illustrating the various styles of lamps manufactured by his company.

Mr. Jno. A. Blatton, traveling representative of the Ries Electric Specialty Company, of Baltimore, Md., says that the Ries regulating socket is making a great many new customers for central stations. Orders are being received from almost every part of America and the Old World where the alternating current is used. This company is compelled by the increase in business to again enlarge its plant.

Widmer & Spranley, dealers in electrical supplies, 78 Custom House street, New Orleans, La., report the following contracts as closed during the past week: J. B. Levert, St. Martensville, La., 210 lights for sugar house; L. M. Soniat, Doruyville, La., 200 lights for sugar house; F. H. Williams, Pattersonville, La., 200 lights for saw mill; the Ætna Rice Mill, Mermentau, La., 100 lights, and the Montecelone Building one 5-h. p. motor.

Messrs. A. Whitney & Sons, Philadelphia, Pa., have issued a neat little pamphlet containing interesting matter on the Master Car Builders' Association and "The Contracting Chill," and also a reprint of the "Circular of Inquiry" of the Committee on Cast Iron Wheels of the Master Car Builders' Association with the answers by A. Whitney & Sons. This little book contains valuable information for those interested in this subject.

The General Electric Company has recently secured a contract to supply to the Cass Avenue Street Railway Company, of St. Louis, Mo., 85 cars, each equipped with two 25-h. p. motors of the well known standard w. p. type, three 800-h. p. direct coupled railway generators of a speed of about 90 revolutions. By this purchase by the Cass Avenue company the entire system of electrical railroads of St. Louis is now solely equipped with apparatus manufactured by the General Electric Company.

The Boehr Electric Company, of Graham street, Brooklyn, is about to remove to larger and more convenient quarters on account of the large increase in its business. The present quarters have proved entirely inadequate. The removal will take place about Oct. 1. This company has recently received an order for a large switchboard 5 feet 6 inches by 4 feet from the Tucker Electrical Construction Company, of New York, in addition to other large orders from various parts of the country.

Mr. A. Bogart, the manufacturer of the Bogart portable dynamo electric gas lighting torch, which was recently put on the market, reports a large number of sales. This invention on account of its absolute safety has proved quite a necessity for hotels, depots, theatres, and especially for the show windows of large stores, where many inflammable materials are displayed. It is a simple device that any one can operate, and is made in two styles, A and B, the former a straight tube, and the latter a curved tube.

The Elmira Electric Illuminating Company is building a new plant at Elmira, N. Y., and has placed the contract for the iron roofs with the Berlin Iron Bridge Company, of East Berlin, Conn. The dynamo room will be 66 feet wide by 177 feet long, covered with the Berlin company's patent anti-condensation corrugated iron roofing, the floor space being controlled by a 10-ton traveling crane. The boiler room will adjoin the dynamo room, and will be 32 feet wide by 75 feet long. When completed this will be one of the best electric light plants in New York State.

The American Engine Company's Works at East Bound Brook, N. J., furnish an interesting illustration of a thoroughly equipped plant. Everything about this shop is complete in every detail. The buildings are thoroughly lighted by electricity, each machine having two incandescent lights placed over it, arranged with portable wires so that all parts of the machine can be lighted. Tramways connect various points throughout the buildings. The machine shop is particularly well equipped and especially fitted for the manufacture of the ingenious form of engine which this company is putting upon the market. This plant was erected at an expense of about $400,000.

The Harrisburg Foundry and Machine Works, Harrisburg, Pa., report the following sales, ready for immediate shipment: One 18 by 18, one 13 by 12, one 10 by 10 Ideal for the Chillicothe Electric Railway; four 12 by 12 Ideals to be used in connection with the Waddell-Entz Electric Company in New York; three 12 by 18 standard Ide engines for Hartford, Conn.; one 11 by 12 and one 7 by 10 for the Racquet Club, New York; two 16 by 16 Ideals for New York City apartment house; one 14 by 20 standard Ide for Perth Amboy, N. J.; one 9 and 10 by 12 Ideal compound for California; two 9 and 15 by 12 Ideal compounds for the Pennsylvania State Insane Hospital; ten 100-h. p. steel return tubular boilers equipped with the Weitmeyer furnace for a hollow-ware company and ten 100-h. p. similar boilers for the Central Iron Company, Harrisburg.

The Purity Oil Filter Manufacturing Company, of Pittsburgh, Pa., reports the following sales during the month of August: Homestake Mining Company, Lead City, S. Dak., Tennessee Manufacturing Company, and the Union Mill Company one No. 2 Ideal Refiner each; Nashville, Tenn., House of Refuge, one No. 3 Ideal; Glens Mills, Pa., and E. H. Kellogg & Co. Oil Company, two No. 2 Ideals; Farmers' Union and Milling Company one No. 2 Ideal; F. & R. Lazarus & Co., one No. 00 Ideal; Southern Pacific R. R. Co., one No. 4 Ideal; Victoria Brewing and Ice Company, one No. 1 Ideal; Alaska Treadwell Gold Mining Company, and Leland Stanford University, each one No. 1 Ideal; Santa Cruz Electric Light and Power Company, one No. 1 Ideal; D. M. Doab, Oakland, Cal., one No. 2 Ideal; Mt. Pleasant (Pa.) Electric Light Company, one No. 1 Ideal; Atwood & McCaffry, Pittsburgh, Pa., one No. 2 Ideal; R. B. Corbett, Nashville, Tenn., two No. 2 Ideals.

The Jewell Belting Company, of Hartford, Conn., reports more orders for driving belts in the past month than in any previous month of their business, as the following list indicates. Jamestown Electric Street Railway Company, Jamestown, N. Y., two 36-in. double belts; Richmond Railway and Electric Company, Richmond, Va., one 56 in. and one 36-in. double; Hartford Electric Light and Power Company, Hartford, Conn., one 60-in. 3-ply and one 44-in. double; Jersey City & Bergen Railroad Company, Jersey City, N. J., three 27-in. doubles; North New York Electric Light Company, New York City, one 48-in. double; Albany Railway Company, Albany, N. Y., one 48-in. double; Elizabeth Electric Light Company, Elizabeth, N. J., one 42-in., 20-in., two 18-in. and others; United Electric Company, Springfield, Mass., one 44-in. double; Chicago, Milwaukee & St. Paul Railway Company, Milwaukee, one 56-in. double; Carroll Electric Light Works, Matteawan, N. Y., one 22-in. double; Wm. Deering & Co., Chicago, Ill., one 48-in. double; Salem Wire Nail Company, Findlay, O., two 40-in. double, two 30-in. double and one 24-in. double.

W. R. Fleming & Co., *Mail and Express* Building, New York City, report the following recent sales of Ide and Ideal engines manufactured by the Harrisburg Foundry and Machine Works, Harrisburg, Pa.: Central Park Apartments, New York City, two 175-h. p. Ideal engines; Raritan and Perth Amboy Electric Light Company, Perth Amboy, N. J., one 150-h. p. Ide; Racket and Tennis Club, New York City, one 35-h. p. and one 70 h. p. Ideal; San Francisco Laundry Association, San Francisco, Cal., one 100-h. p. tandem compound Ideal; Edison Spanish Colonial Company, New York City, two 25-h. p. Ideal engines for steamships Mexico and Panama; Rubber Reclaiming Company, New York City, one 15-h. p. Ideal; Canfield Rubber Company, Bridgeport, Conn., one 30-h. p. Ide; Hotel Beresford, New York City, two 45-h. p. Ideals. They have just completed a plant for Hotel St. Lorenz in New York City that consists of two 60-h. p. Ideal engines, and are also installing in the Century Club in this city one 50 and one 60-h. p. Ideal. They have also recently taken several contracts for complete steam plants and are now erecting the following: Hotchkiss School Association, Lakeville, Conn., one complete plant of 70-h. p. Ideal engine and 90-h. p. horizontal tubular boiler; Mount Vernon Construction Company, Alexandria, Va., complete boiler plant of 300-h. p.; Municipal Electric Light Station, South Norwalk, Conn., complete plant of 100-h. p. Ideal engine and 125 h. p. horizontal tubular boiler.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

A Most Valuable Work.—Mr. Geo. A. Trower, of Richmond, Va., expresses the following opinion regarding "Houston's Dictionary of Electrical Words, Terms and Phrases:" "I think Houston's Dictionary a most valuable work, and consider my $5 well invested."

Lamp Factory for Sale.—An incandescent lamp plant of modern construction, now running with a capacity of 600 lamps a day, can be purchased outright, or an interest in same secured at a reasonable price. A rare chance for a good investment is here offered. Address HIGH EFFICIENCY,
465 "The Rookery," Chicago.

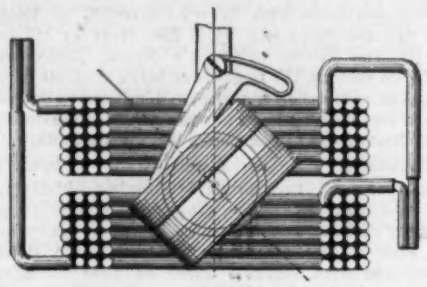
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

U. S. PATENTS ISSUED SEPT. 6, 1892.

481,956. Automatic Trolley-Disconnector; George A. Kimball, Seattle, Wash. Application filed Nov. 21, 1891. In an automatic trolley-disconnector, the combination of a trolley-pole, a cord attached thereto, and a pivoted trigger adapted to trip a weight which is normally hung within a slot formed in the short arm of the trigger.

481,959. Conduit System for Electric Railways; Reuben Lawrence, St. Joseph, Mo. Application filed Jan. 27, 1890. In an electric railway conduit, the combination of the removable cover plates, having a slot opening between them, side plates, brackets fixed upon the ties of the railway, supporting and forming the framework of the conduit, and the longitudinal rail-carrying sills also supported by the brackets.



No. 481,975.—Meter for Alternating Electric Currents.

481,975. Meter for Alternating Electric Currents; Oliver B. Shallenberger, Rochester, N. Y. Application filed Sept. 27, 1889. In an electric meter, a closed secondary circuit composed of circuits of conducting material and metallic connections between the successive circuits. (See illustration.)

481,988. Power-Transmitting Device; Elbert D. Weyburn, Chicago, Ill. Application filed April 16, 1891. This invention comprises a suspended traveling carriage, a power-transmitting device, a hollow shaft or tube depending from this carriage, a driving shaft passing through the tube, a second hollow shaft to which the other ends of the arms are rigidly attached, a second driving shaft passing therethrough and additional arms loosely attached at one end to the second hollow tube and carrying the cutting-tool, and connections between the power-transmitting device and the first driving shaft, the latter and second driving shaft, and between the second driving shaft and the cutting-tool.

481,989. Electric Fire and Burglar Alarm Connection; Homer T. Wilson, Louisville, Ky. Application filed June 9, 1892. The combination of two blades bent to form a loop, which is provided with a melting composition, so that the apparatus may be open circuited either by pressure upon a projecting spring and used for a burglar alarm, or by the melting out of the composition when used for a fire alarm.

481,999. Electric Furnace Generator; Emile Berliner Washington, D. C. Application filed May 18, 1891. In an electric generator, the combination of an electromagnet and an armature supported by non-magnetic material, with a heater for heating the armature and a cooler for intermittently cooling the same. (See illustration.)

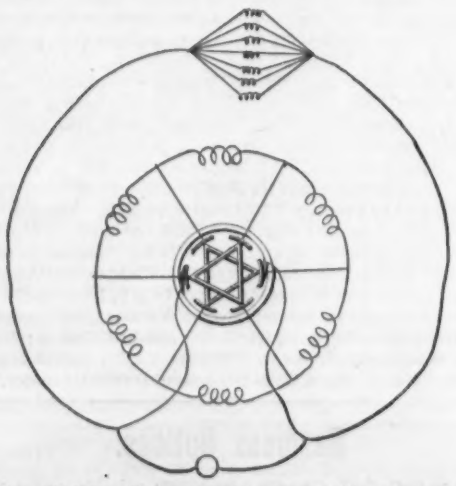
482,012. Battery-Connector; Edward R. Knowles, Brooklyn, N. Y. Application filed Oct. 15, 1891. The combination, with the electrode of an electric battery, of a screw-threaded projection provided with a shoulder, and a conical shaped projection, all composed of a hard, non-oxidizable metal or alloy.

482,015. Printing or Recording Telegraph; Zachary T. Lillard and Ursinus Erhard, Kansas City, Mo. Application filed Jan. 23, 1892. A printing or recording telegraph apparatus, comprising a receiver consisting of a number of pivotal type-carrying bars, a number of electromagnets, each having its armature mechanically connected to one of the type-carrying bars, an impression cylinder journaled above the type-carrying bars, a lower presser roll geared to the lower press roll, a drum carried by the impression cylinder, a band connected to the drum, and a gravity weight connected to the band.

482,031. Trolley for Electric Railways; Clarence A. Adams and Thomas J. Thorp, Lincoln, Neb. Application filed March 25, 1892. The combination, with a harp adapted to support a journal for a trolley-roller, of pockets cast on the harp and springs inserted in the pockets and adapted to bear on the trolley wheel.

482,032. Electrostatic Switch and Phase-Indicator; Alfred Upton Alcock, Melbourne, Victoria. Application filed May 26, 1891. A system of electrical distribution consisting of the combination of electric alternators, circuit closers therefor, and means for operating the circuit closers, consisting of relatively movable plates respectively charged by different alternators.

482,043. Storage Battery; Patrick Kennedy and Charles J. Diss, Brooklyn, N. Y. Application filed Sept. 25, 1891. In a storage battery, a conductor constructed and arranged for connection with electric wires and having openings therethrough, active material arranged at opposite surfaces of the conductor, and non-conducting material for holding the same against the opposite sides of the conductor constructed to meet at intervals through the openings therein.



No. 481,999.—Electric Furnace Generator.

482,044. Storage Battery; Patrick Kennedy and Charles J. Diss, Brooklyn, N. Y. Application filed Sept. 25, 1891. A structure for holding the active material of a storage battery, composed of a cohesive bitumen, resin, gum or gum resin and a mineral non-conductor of electricity.

482,074. Electrical Heater; John V. Capek, New York. Application filed March 5, 1891. An electrical heater consisting of an insulated heating conductor and an enclosing box or case having a cover, a metal plate on the box cover, and a screw or similar device passing through the plate cover and box and connecting the three parts together.

482,093. Rheostat; Harry W. Lawrence, Denver, Colo. Application filed April 25, 1891. A rheostat consisting of an insulating block provided with a series of plates insulated from each other, metal screws passing through the block into the plates, a carbon resistance supported on the block and provided with clamps surrounding the carbon and secured by adjusting screws, a wire connecting each of the metal screws to the adjusting screws, a rotating metal stem secured to the plate and provided with a metal arm adapted to engage the series of plates, and a circuit, the wires of which are electrically connected, respectively, with the stem and the plate at one extremity of the series of plates.

482,104. Ceiling-Block for Incandescent Lamps; Luther Stieringer, New York. Application filed July 3, 1886. The combination, with a ceiling block having a perforated projecting pin, of flexible lamp conductors depending therefrom, and electrically connected with contact devices on the block, the wires being threaded through holes in the pin to remove the weight from the electrical connections.

482,126. Train Signaling Apparatus; James M. Henry, Wilmerding, Pa., and Robt. B. Wilson, Altoona, Pa. Application filed Dec. 23, 1891. A sounder having an admission port leading thereto, a main valve controlling the port, a piston working loosely in a cylinder and bearing against the main valve stem, a branch port leading to one side of the piston, a secondary valve controlling the branch passage, a lever bearing on the secondary valve an electromagnet and an armature carried upon the lever.

482,129. Combined Telegraph Key and Sounder; Dan J. Ludwig, New York. Application filed May 2, 1892. The combination of a bifurcated frame, the key and armature lever pivoted and playing between the sides or bifurcations of the frame and the sounder magnet supported above the armature lever. (See illustration.)

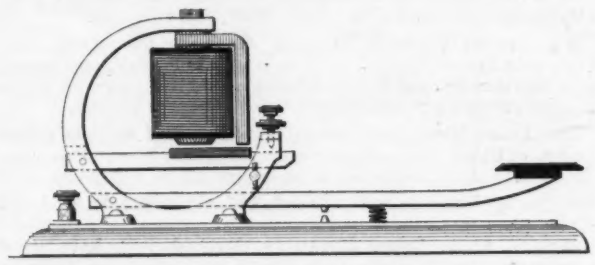
482,136. Automatic Battery Cut-Off; Walter S. Richards, Natick, Mass. Application filed Jan. 3, 1891. In a telegraph, the combination of a line circuit, a battery or equivalent generator connected therewith, two relatively movable terminals or contacts connected with the poles of the generator, with a local circuit controlled by the main line and a circuit-controller controlled by the local circuit, actuating to separate the contacts by the closing of the local circuit and to momentarily close the contacts and then separate them again when the local circuit is opened.

482,137. Electrically Adjusting Relay; Walter S. Richards, Natick, Mass. Application filed Sept. 14, 1891. In an electric circuit, the combination, with a relay located in the circuit and its armature, of an electromagnet included in the same circuit with the relay and provided with an armature pivoted outside of the electromagnet and located in front of the pole-piece of the electromagnet and a spring connecting the armatures.

482,139. Electric Valve Controller; Edward F. Roberts, Columbus, O. Application filed Aug. 26, 1890. In a heating system, the combination of a valve for controlling the heating fluid, provided with differential pistons on the opposite sides thereof, the one open to and adapted to be operated by excess of pressure and the other by an electromagnet included in an electric circuit which also includes a thermostatic device controlled by a variation of temperature. (See illustration.)

482,148. Tell-Tale for Electrolytic Refineries; Francis B. Badt, Chicago, Ill. Application filed May 16, 1892. In a tell-tale for electrolytic vats, the combination of a series of vats coupled in series, with a series of visual signaling devices, each in a normally closed local circuit, including itself and one vat.

482,149. Electrical Circuit and Cable; John A. Barrett, Brooklyn, N. Y. Application filed Jan. 8, 1891. An electric circuit consisting of a pair of naked conductors and a single mesh of cord, tape or similar insulating material woven between and about the conductors and constructed to form a flat band circuit, with a greater thickness of the woven insulating material between them about the conductors.



No. 482,129.—Combined Telegraph Key and Sounder.

482,150. Electric Conductor; John A. Barrett, Brooklyn. Application filed Jan. 8, 1891. An electric conductor or groups of conductors having a covering consisting of a strip of paper cloth, or other flexible material wound about the conductor or group of conductors, and provided with tucks extending transversely to the lines of flexure.

482,151. Electric Conductor; John A. Barrett, Brooklyn N. Y. Application filed July 17, 1891. In an electric cable, the combination of a plurality of independent circuits, each circuit consisting of a pair of conductors formed into a single strand by a covering of paper or other insulating material applied about both conductors, and secured to hold the conductors at a distance apart greater than the distance between conductors of adjacent circuits in the cable.

482,152. Electric Conduit and Cable; John A. Barrett, Brooklyn, N. Y. Application filed Aug. 28, 1891. A single strand anti-induction circuit consisting of a pair of flat conductors arranged edgewise with relation to each other.

482,157. Electric Arc Lamp; John T. Birch, Pittsburgh, Pa. Application filed April 4. In an arc lamp, the combination of two hubs, each provided with radially arranged holders for carbon rods, a series of cam projections connected to the shafts carrying the hubs, and reciprocating dogs engaging the projections and thereby rotating the shafts and hubs.

482,171. Feed Indicator for Boilers; Andre Gusaco and Ange Chusin, Marseilles, France. Application filed Oct. 8, 1891. In combination, a tubing having openings in its sides, a valve with its casing, a movable stem, carrying indicator, an inner glass tube, terminals, contact connected with the stem and means for supporting the terminals closing the end of the tube and holding the parts in place.

482,172. Electrical Gas Lighter; James E. Hamilton, Chicago, Ill. Application filed March 11, 1892. In an electric gas-lighting device, the combination, with a gas burner with insulated spurs on each side of the slot thereof, of a shaft on the end of the gascock parallel with its axis and revolving therewith, provided with an arm carrying a wiper adapted to make and break contact with the spurs.

482,174. Telephone-Exchange Apparatus; Angus S. Hibbard, New York. Application filed June 2, 1892. The combination, with a series of telephone service-circuits, an order-circuit, an operator's receiving-telephone, and a circuit-changer controlling the connection of the telephone with the service-circuit, of a repeating coil having one of its windings connected with the order-circuit and an independent loop extending from the terminals of the receiving-telephone and formed into a closed circuit with the other winding of the repeating-coil.

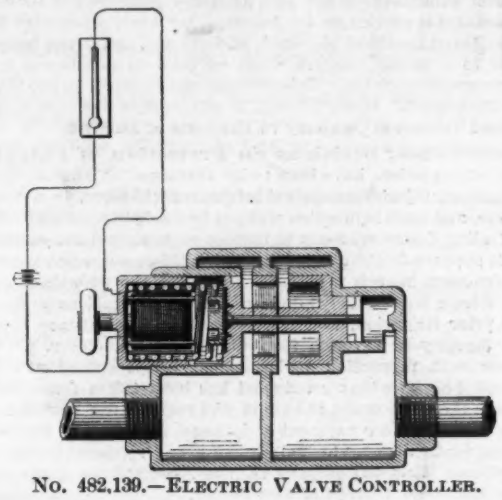
482,177. Electrical Conductor; Philip Henry Holmes, Gardiner, Me. Application filed Jan. 2, 1892. An electric conductor composed of particles of electric-conducting carbon and divided fibre disposed in strata which lie in planes parallel with the direction of the current.

482,181. Electric Connector for Hose; Charles F. Keilom, Delair, N. J. Application filed Dec. 31, 1891. A hose-coupling having one of its collars provided with a gasket and the other collar provided with the fingers, a segmental ring seated on the gasket, adapted to contact with the fingers, and electric wires connected with the ring and fingers.

482,209. Induction Coil for Electric Meters; Elihu Thomson, Lynn, Mass. Application filed March 5, 1889. The combination, on the same iron core, of three coils, one of few turns carrying current in direct proportion to the current to be measured, a second carrying current in derivation to the work and tending to help the first, and a third into the circuit with an electric meter for measuring the current consumed in the work. (See illustration.)

482,240. Electric Arc Lamp; James E. Gaston, Sparta, Ill. Application filed May 31, 1892. In a positive feed arc lamp, a clocktrain having a high-speed wheel in combination with a combined detent and brake shoe constructed and arranged to engage the teeth of the wheel simultaneously as a detent and brake shoe.

482,253. Electric Arc Lamp; Jesse E. Kester, Terre Haute, Ind. Application filed May 13, 1892. In an electric arc lamp, a globe holder having in its base plate an opening, a pivoted door or latch adapted to close such opening, a lug projecting from the lamp frame, adapted to pass through the base plate of the globe holder, and a pivoted door or latch of the base plate adapted to engage with the notch in such lug and thereby support the globe holder.



No. 482,139.—Electric Valve Controller.

482,263. Electric Annunciator; Erastus D. Moore, New York. Application filed Feb. 18, 1892. The combination of a frame having a slot therein and two projecting arms, a core mounted in a position approximately parallel with the slot, the armature pivotally mounted in the slot, an indicator plate pivoted between the arms of the frame and engaging the armature, and a spring adapted to throw the indicator plate away from the armature when the armature releases the plate.

482,265. Armature for Dynamo-Electric Machines; John Nebel, of Charlton, Westminster, England. Application filed Nov. 11, 1891. An armature of a dynamo-electric machine, having its conducting bars, not less than eight in number, divided into two, three or n sections, and this number increased or diminished by adding or substracting 2, 4 or $2n-2$, each bar of the number so determined being connected, not to that opposite to it, but to the second, third or nth before the opposite, and each brush touching two, three or n commutator segments, of which there are half as many as there are bars.

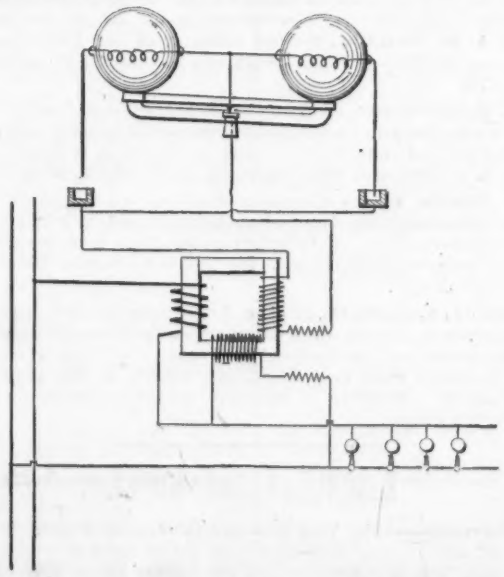
482,270. Means for Drawing Cables into Conduits; Thomas F. O'Connor, New York, and Joseph W. Marsh, Pittsburgh, Pa. Application filed Jan. 8, 1892. As a means for introducing cables into conduits or ducts and preventing undue strain thereof, the combination of a series of draw wires connected to the cable at different points along its length.

482,297. Electric Insulator; William H. Clark, Brooklyn, N. Y. Application filed May 21, 1891. An insulator for electric wires, having a screw threaded stem and a flat collar over the stem to protect it from moisture, the insulator having a square hole in its lower end and being provided with a depression in its top, and with side projections.

482,306. Electric Railway Signal; Charles K. Hall, New Orleans, La. Application filed April 4, 1892. This apparatus consists of two continuous conductors insulated from each other and connected from car to car throughout the train, a contact maker in the engine, adapted to electrically connect the conductors, and an electric bell and a source of electricity in each car, electrically connected together and having one terminal connected to a contact strip connected to one of the conductors and the other terminal connected to a contact strip insulated from both conductors, and a switch in each car, adapted to connect either the second continuous conductor to the insulated contact strip or to connect the two continuous conductors together.

482,323. Magnetic Separator for Ore Concentrators; Charles E. Seymour, Lake Geneva, Wis. Application filed Oct. 2, 1891. In an ore concentrator, the combination of a concentrator pan or bowl, means for magnetizing the same, an electric circuit, spring actuated contact points within the circuit, a pivoted key provided with an arm bearing upon one of the contact points, and a vertical rod connected to the outer end of the key.

482,324. Electric Meter; Francis Teague, London, England. Application filed Nov. 17, 1891. An armature vertically suspended on pivots and rotatable in a truly concentric annular field, the armature axle being immersed nearly the whole of its length in an insulated central mercury cup sunk within a polar extension and the outer part of the armature immersed in an adjustable annular mercury cup.



No. 482,209.—Induction Coil for Electric Meters.

482,325. Trolley for Electric Railways; James M. C. Tyner and Samuel S. Irving, Minneapolis, Minn. Application filed Nov. 30, 1891. A trolley carrying a series of fingers adapted to meet over the trolley-wire at a point in the rear of the trolley wheel.

482,328. Electric Cable; John A. Barrett, Brooklyn, N. Y. Application filed Aug. 23, 1891. In an electric cable, the combination with an enclosing sheath of a plurality of cores and electric conductors forming one or more circuits secured in position upon each core, the cores being constructed to provided space for dry-air insulation between the conductors.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.